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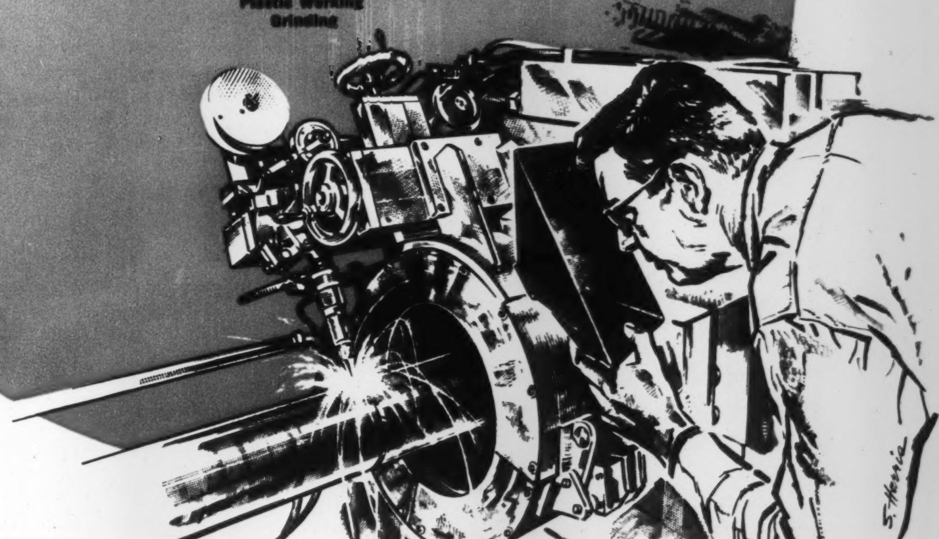
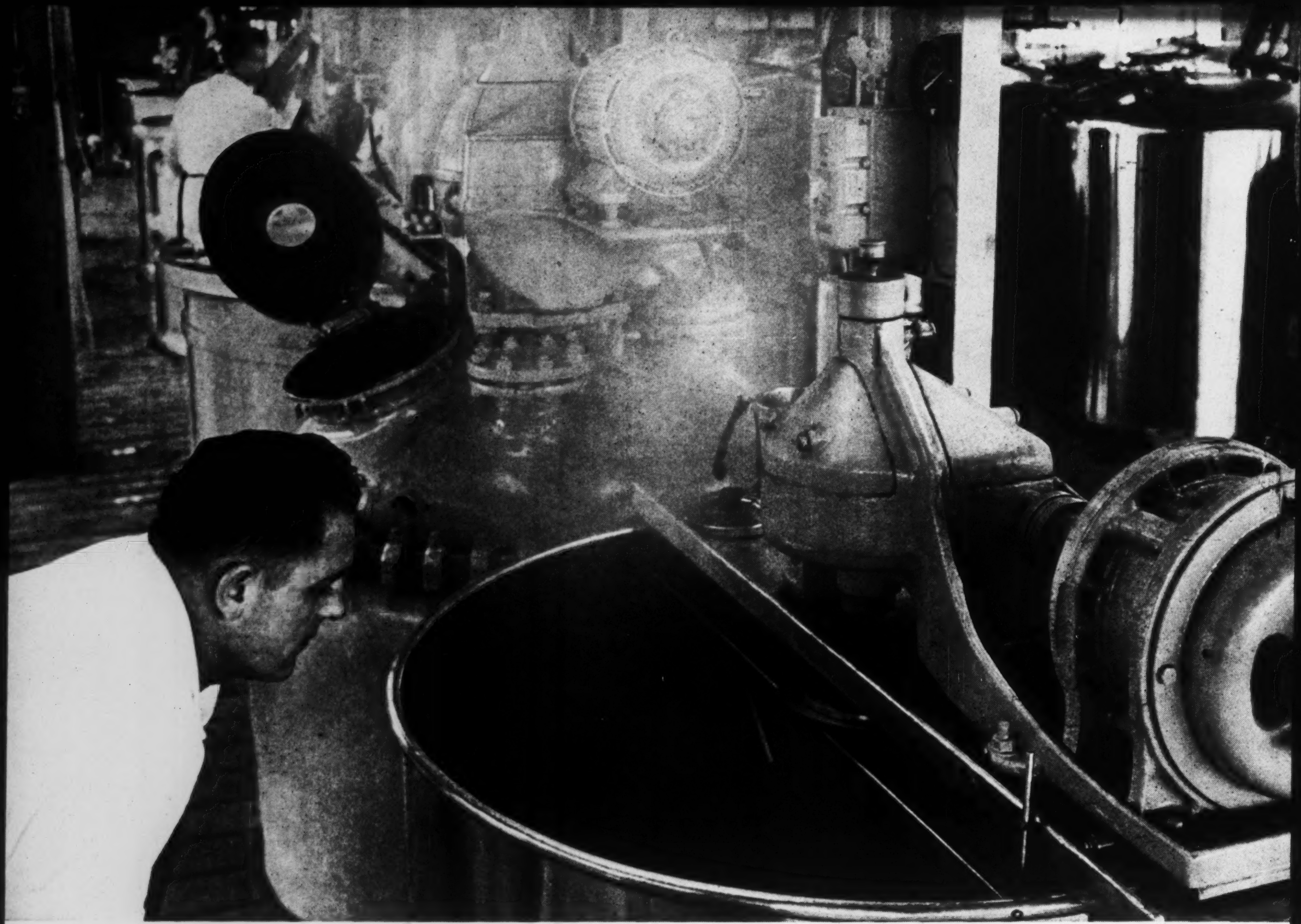


Automatic Machine Welds Aluminum Pipe



Steam Supply by B & W

Keeps Boiler Room Hospital-Clean at Hoffmann-La Roche

Pharmaceutical Manufacturer Meets Expanded Needs in Small Space

Spotless housekeeping, important throughout a pharmaceutical plant, was extended to Hoffmann-La Roche's boiler room at Nutley, New Jersey, when two new B&W units were installed. The new boilers meet expanding plant needs in a small space. They also take wide load variations in stride—on less fuel. Steam plays a multiple role in processing this famous line of pharmaceuticals, and the B&W Boilers provide a dependable, low cost supply of clean, dry steam.

No matter how you use steam, for processing or only for heating; no matter how large or small your demand is, it will pay you to look at your steam costs. You'll be surprised how much money you're burning. And that's the money that really matters—not the initial cost of the boiler.

Most boilers consume their initial cost in fuel every year. During the normal life expectancy of many boilers, the fuel bill can amount to several million dollars. Unless it is well-engineered, well-serviced, and well-maintained, the efficiency of a boiler can drop off 2 or 3 per cent or even more. This amounts to a substantial sum of money.

You save on your steam supply with B&W Boilers. That's why it pays to buy the best for your steam operations—B&W's top level engineering, long range sustained economy, and best performance. A national network of plants and engineers, supported by nearly a century of steam generating experience, is yours. Talk over your steam needs with B&W.

The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

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BOILER DIVISION

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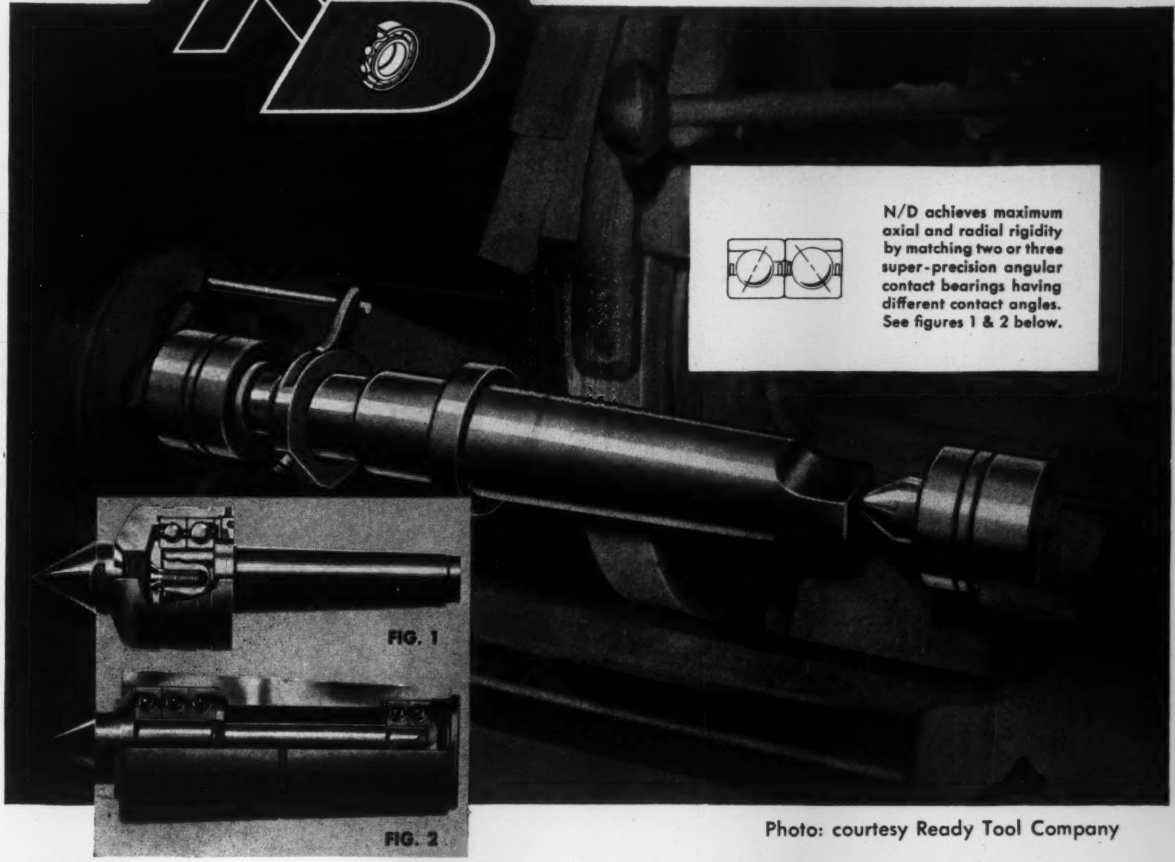
CASE HISTORIES



N/D achieves maximum axial and radial rigidity by matching two or three super-precision angular contact bearings having different contact angles. See figures 1 & 2 below.

FIG. 1

FIG. 2

Photo: courtesy Ready Tool Company

Bearing Design Helps Live Center Maker Achieve Accuracy of .000050"!

CUSTOMER PROBLEM:

Live center maker requires bearing design that will help achieve . . . and maintain . . . live center accuracy of .000050", under combination radial and thrust loads.

SOLUTION:

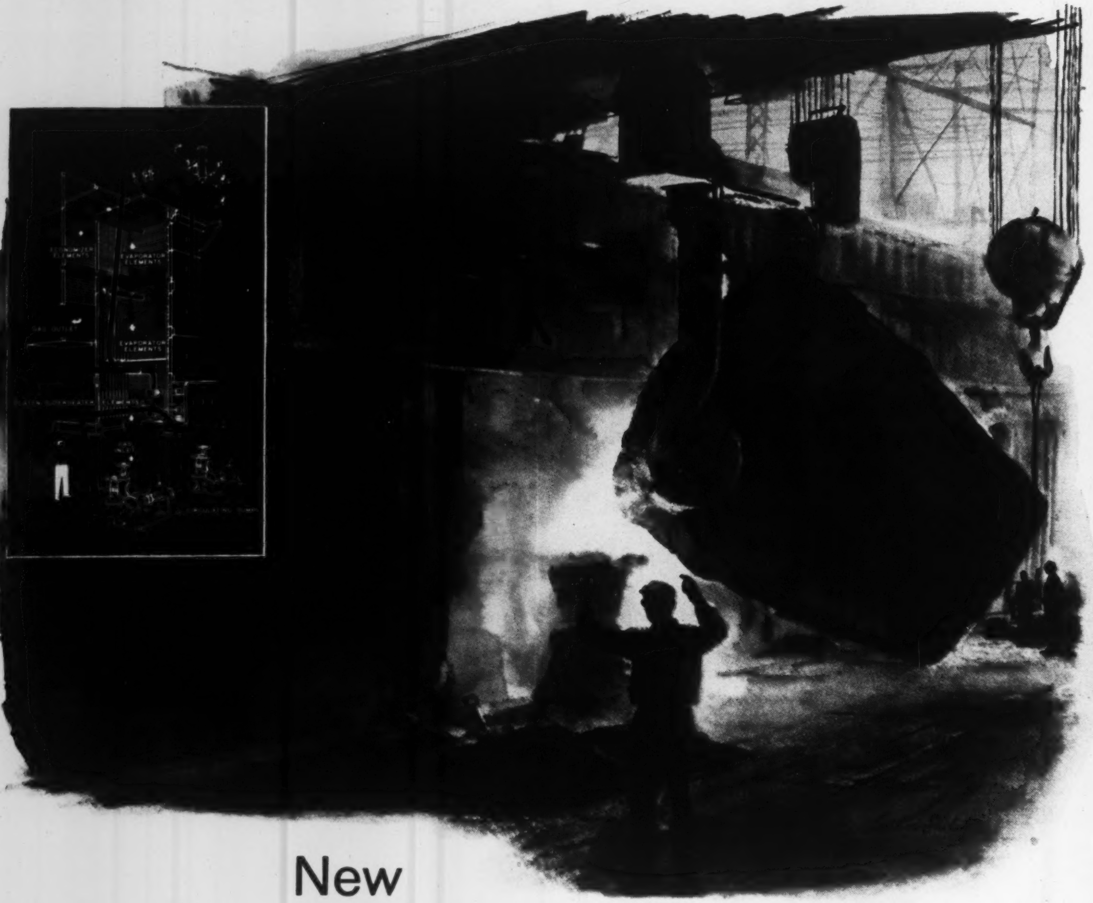
After thorough evaluation of the problem, New Departure recommended N/D pre-loaded, duplex ball bearings. Extensive testing proved these super-precise ball bearings resisted combination radial and thrust loads with minimum deflection. The N/D ball bearings, with medium and high contact angles, are mounted duplex and positively clamped together to assure the optimum, pre-determined preload condition. As work expansion increases the thrust load, radial centering becomes more rigid and accuracy is precisely maintained . . . to less than .000050" total indicator run-out!

When you're working on new designs that call for high precision ball bearings, why not call on New Departure? New Departure's consistent precision is your assurance of the ultimate in accuracy for your design. For more information, call the New Departure Sales Engineer in your area or write Dept. U-9.

Replacement ball bearings available through
United Motors System and its Independent Bearing Distributors

NEW DEPARTURE
DIVISION OF GENERAL MOTORS, BRISTOL, CONN.
NOTHING ROLLS LIKE A BALL

"CREATIVE ENGINEERING" GUIDES STEEL MILL WASTE HEAT INTO MORE PRODUCTIVE CHANNELS



New "Package" Boiler squeezes more steam out of by-product BTU's

The open hearth furnaces of a steel mill produce large quantities of very hot gas. Frequently, this heat-laden gas is used to generate steam for the mill by passing it through "fire tube" boilers. But the limitations inherent in this type of boiler prompted Combustion—an organization with more than 75 years of experience in harnessing heat—to develop a new boiler concept to better meet this special need.

The result is the C-E Waste Heat Boiler, Type WCC, a completely shop-assembled (package) unit. Its unique feature is the use of "Controlled Circulation," as developed by C-E for large utility boilers and now generally regarded as the most important development of this decade in the field of steam generation. This feature enables the WCC Boiler to produce substantially greater amounts of steam from the same volume of waste gases. The WCC Boiler is expressly designed to handle "sticky" or abrasive gases without erosion, and with minimum maintenance. It therefore promises important advantages for many applications outside the steel industry—notably, in the chemical process industries.

Here then is another example of Creative Engineering—the C-E approach to providing the most advanced designs of boilers for all fuels and steam requirements—from those of small industrial and institutional plants to the largest utility power stations.

"CREATIVE ENGINEERING" is the reason for the leadership attained by C-E products. The products which bear this mark of leadership include:

all types of steam generating, fuel burning and related equipment · nuclear power systems · paper mill equipment · pulverizers · flash drying systems · pressure vessels · soil pipe

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THE COVER

The price gap between aluminum and steel pipelines may be narrowed by this automatic pipe-welding machine developed by the Aluminum Company of America, Pittsburgh, Pa., to produce sound welds with full penetration—and without the use of back-up rings. This unit can process all tubular products with OD's of 4 in. to 11 in. and completes a pass on 4-in. pipe in 11 sec. The head, which can be positioned through a wide range of welding angles, can also be set to oscillate across the weld width, insuring complete filling.

MANAGEMENT LOOKS AT MAINTENANCE................Glenn B. Warren **46**

The problem: To preserve an economic balance between short-range and long-range objectives in the whole field of maintenance and plant engineering. The trend is toward "productive maintenance."

UTILITIES STUDY INCREMENTAL MAINTENANCE COSTS..R. H. Holyoak **48**

They hold down the cost of electric power by incremental loading. Next step: To learn how maintenance costs vary with load. From Commonwealth Edison comes this report on the new cost studies.

CENTRAL JOB SHOP IN AREA MAINTENANCE..............C. H. Harker **50**

Automotive repair, sign painting, blacksmithing, sheet-metal work, upholstery—should you buy such services? If you provide them in a central job shop, what are the principles of organization?

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Each year, engineers understand more about the mechanism of metal forming. Here are listed the outstanding studies for 1958. Are you up on developments in chip-tool contact? On impact extrusion?

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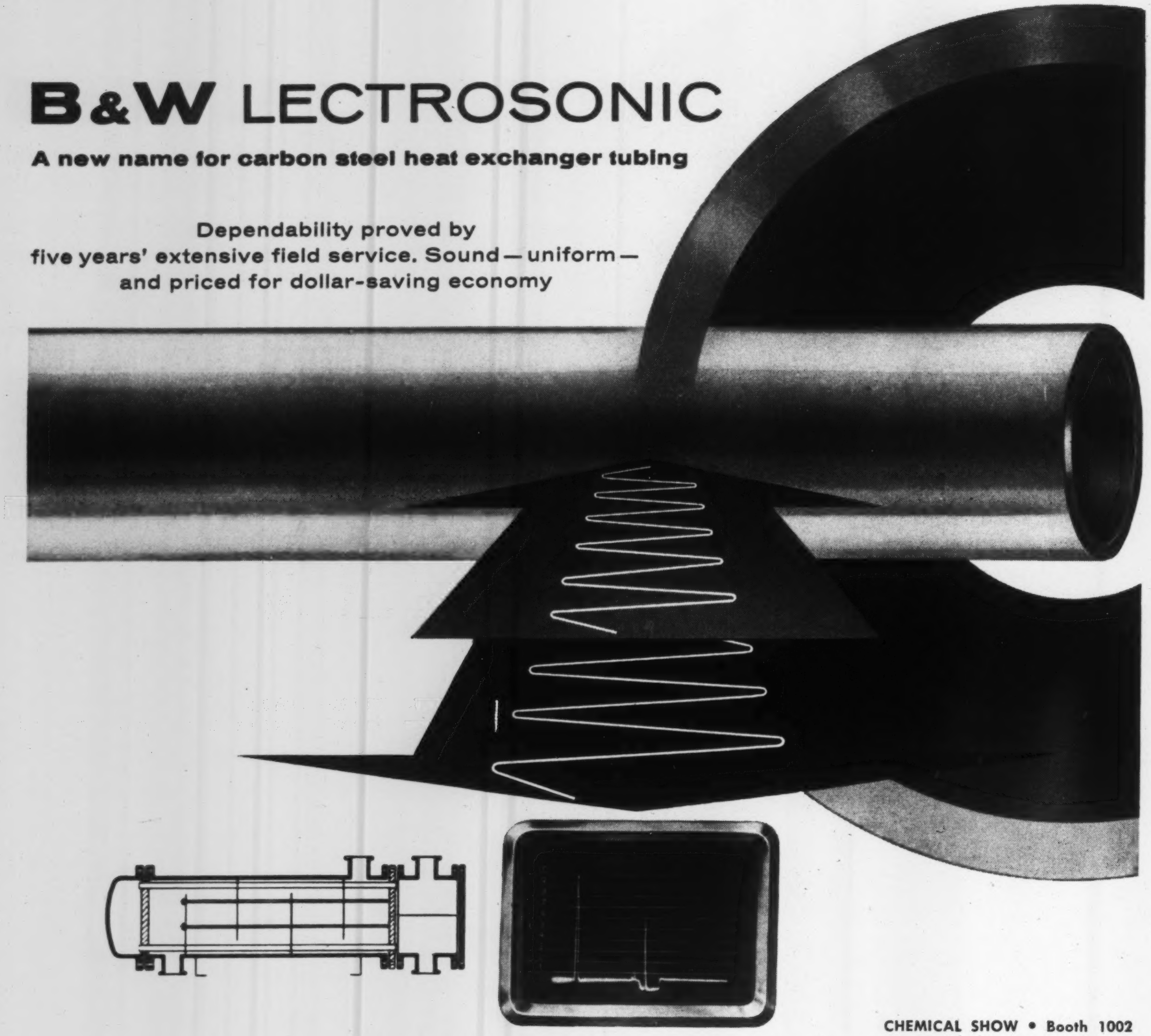
A new name for carbon steel heat exchanger tubing

Dependability proved by
five years' extensive field service. Sound — uniform —
and priced for dollar-saving economy



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Now, B&W brings you a new concept in heat exchanger tubing—B&W LECTROSONIC. Produced under the most exacting quality control methods in the industry, LECTROSONIC tubing fits right, and rolls in easily because it's dimensionally accurate, and uniform.

Continuous ultrasonic inspection—plus destructive and hydrostatic testing, visual inspection, and magnetic particle inspection, are five ways used to check the weld of B&W LECTROSONIC Tubing for your assurance of dependability.

B&W LECTROSONIC Tubing was developed to meet the needs of the petrochemical industry for an electric resistance welded carbon steel tube that is easily workable, strong, and less costly than seamless tubing which it is designed to replace.

Produced in all standard sizes. Available now through distributors or direct from B&W.

Write for B&W Bulletin TB-431 for full information, or call your nearest B&W District Sales Office. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

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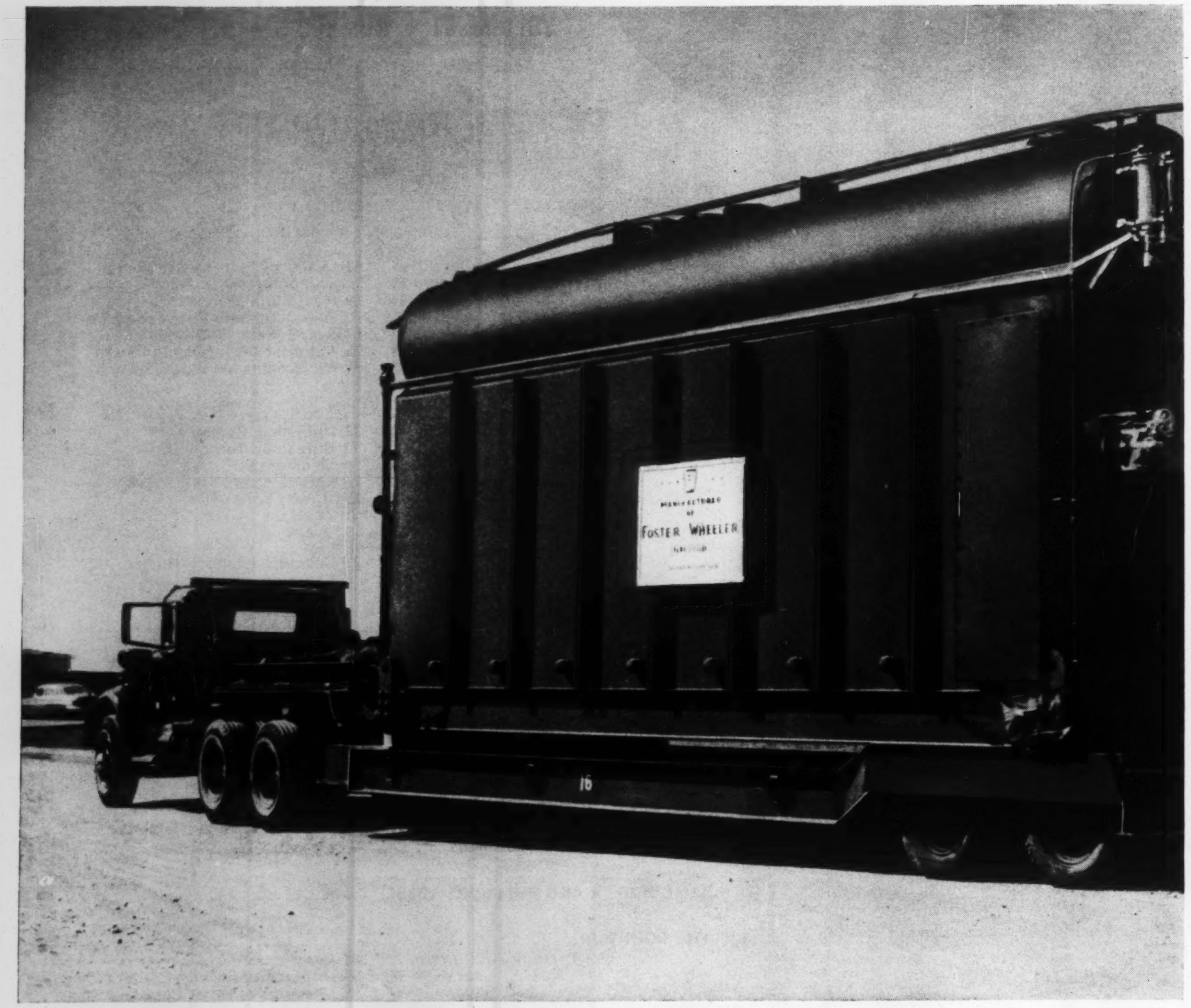
MANUFACTURED BY
FOSTER WHEELER
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Foster Wheeler Packaged Steam Generator on its way to a refinery, where it is now producing 50,000 lb/hr of high-purity steam for processing and heating purposes.

—PETROLEUM PROCESSING

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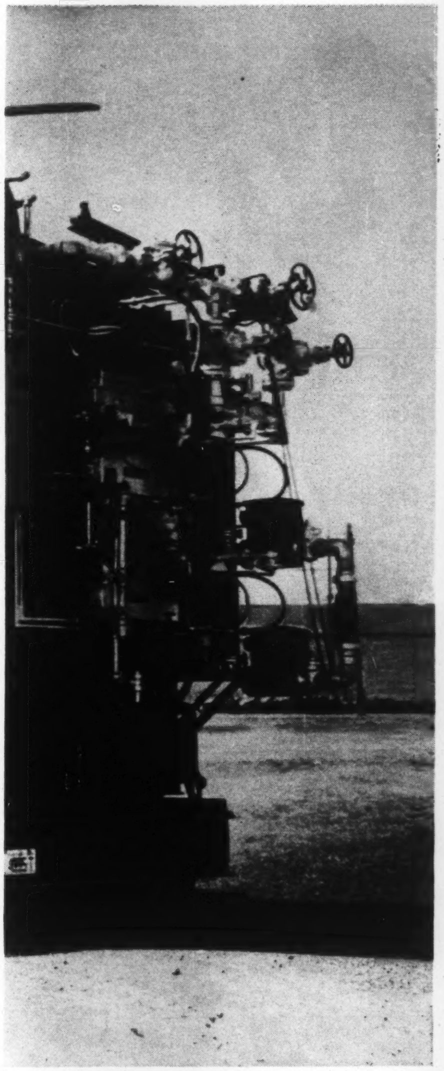

Foster Wheeler delivers the steam you need and the economy and efficiency you want, in one package

If you need 13,000 lb/hr or more of steam at pressures of 250 psi or above, one of the best ways to begin planning your steam generator installation is by contacting Foster Wheeler right now.

This is Foster Wheeler's record of experience in meeting steam requirements with packaged steam generators.

The first water tube shop-assembled packaged unit was built by Foster Wheeler in 1940, to solve an important defense problem. Today, standard Foster Wheeler Packaged Steam Generators, firing fuel oil and gas separately or in combination, are serving refineries, process and manufacturing plants, hotels, dairies . . . virtually every type of business and industry throughout the world.

Most recent Foster Wheeler development in packaged steam generators is a stoker fired model, the first available to industrial users of steam.

In short, the *heat engineering* experience that goes into Foster Wheeler Packaged Steam Generators is unique in the power industry. And the result is a product engineered for dependable, economical and efficient production of high-purity steam . . . and delivered as a package which keeps installation costs to a minimum.

Make planning your steam generator installation easier by getting full information on Foster Wheeler Packaged Steam Generators *before* you start writing your specifications. Write Foster Wheeler Corporation, 666 Fifth Ave., New York 17, for Bulletin PG-58-2. Or better still, contact Foster Wheeler directly and discuss your steam requirements personally with one of Foster Wheeler's *heat engineering* specialists.

Heat Engineered products, plants and processes . . . for the world's power, petroleum and process industries.

—SPECIALIZED INSTALLATIONS

FOSTER WHEELER

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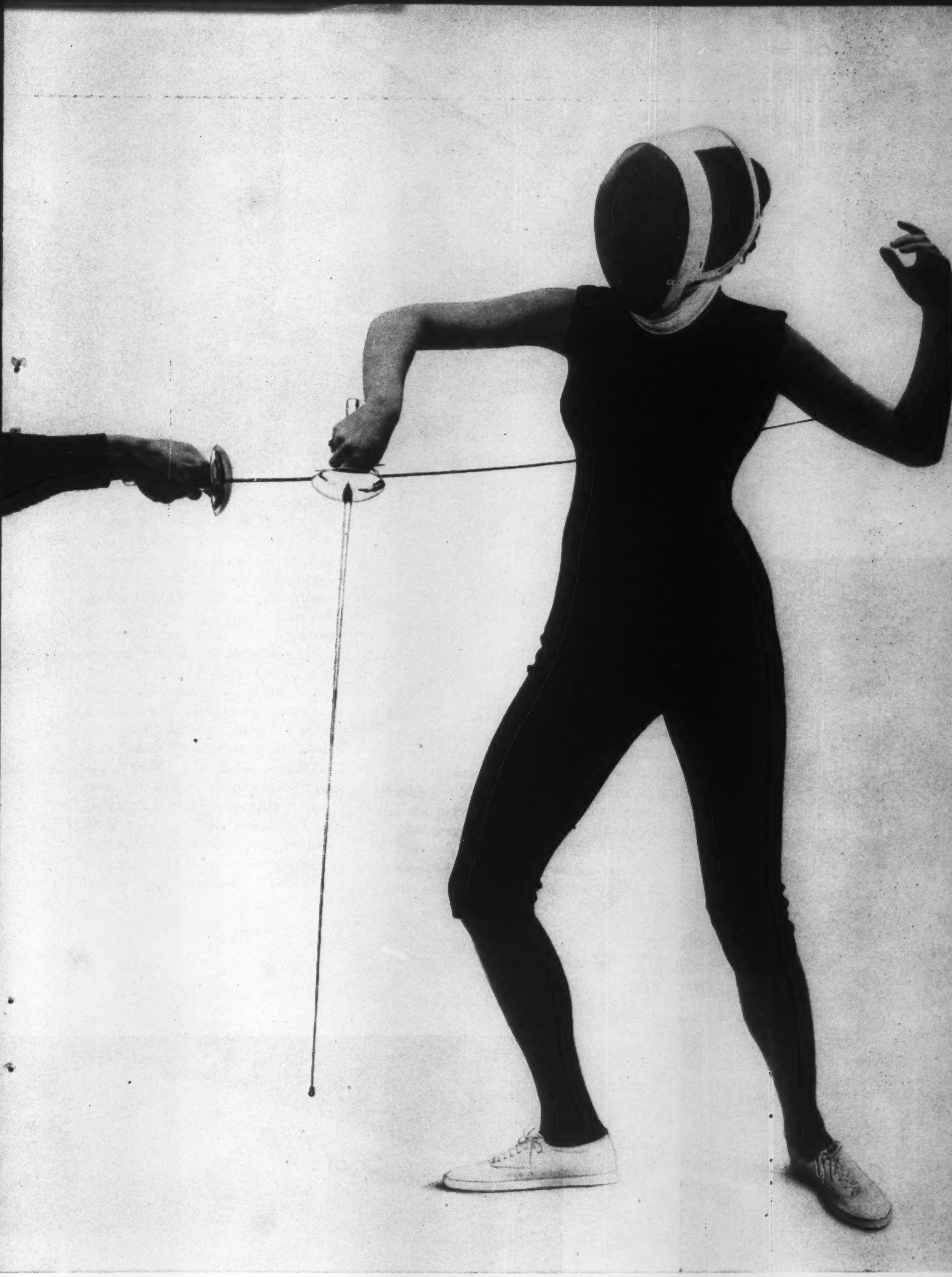
Foils must be light—they must be steel There was a time when your very life depended upon

and tough enough to spring back unharmed after countering the intended death blow. These characteristics have



STEELS FOR DESIGN

your blade. It had to be as light as human ingenuity could make it. But it also had to be strong,

made steel the most important metal in the history of man. For some modern, lightweight examples, turn the page ▷ ▷ ▷

CHAPMAN TRANSPORT INC.

STEELS FOR DESIGN

Stainless Steel builds a stronger, lighter trailer. This 40-foot trailer is one of the latest models designed and built by the Fruehauf Trailer Company. It's the strongest, lightest trailer in its class because it was built with Stainless Steel. The Stainless has a yield point of 120,000 psi, almost four times greater than competitive materials, so the walls, roof, and braces could be made thin and very light, yet they are rigid and strong. The exceptional corrosion resistance of Stainless Steel practically eliminates maintenance. This trailer will never have to be painted or refinished and it will still look clean and new after many thousands of miles.

High Strength Steel cuts cable reel weight 25%. The George Evans Corporation is the largest manufacturer of cable reels in the United States. Each of these reels has to carry and protect about $5000 worth of cable—seven tons of it. The reel must be strong and rugged or it will buckle under its load as it bumps over rocks and timbers in the field. It must *also* be exceptionally light, or freight costs will be exorbitant and field handling almost impossible. For a long time, these reels were made of wood and they lasted about two years. Then, the company started to make an all-steel reel, with the rims made of USS COR-TEN High-Strength Low-Alloy Steel. The COR-TEN Steel reels are much stronger and they weigh 25% less than wooden reels. They *cost less*, too, because they cut freight charges; they practically eliminate maintenance; and they will last about twenty years.

USS "T-1" Alloy Steel cuts tanker weight, increases payload. Trinity Steel Company of Dallas, Texas, makes LPG transport tankers and recently the company tripled production to meet the demand for its new, lightweight models. Trinity increased the payload of these tankers substantially by cutting the weight of the carrier itself as much as one-third. They used USS "T-1" Constructional Alloy Steel. Because "T-1" Steel is extremely strong—100,000 psi minimum yield strength—the tank walls are made about 1/3 thinner—with a comparable reduction in weight. And the weldability of "T-1" Steel meets the rigid ASME code that requires X-Ray and magnetic particle inspection of all joints.

USS, "T-1" and COR-TEN are registered trademarks

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Founded in 1900 for the purpose of building textile machinery, Barber-Colman Company today produces diversified equipment and products for such fields as automotive, aviation, machine tool construction and textile.

Versatile ACIPCO centrifugally spun TUBES

...for super speed warpers

Barber-Colman Company, Rockford, Illinois, manufactures more than 85% of the section beam warpers produced in the world. And Barber-Colman specifies ACIPCO Centrifugally Spun Cast Iron Tubes as supplied through our mid-west distributor, C. A. ROBERTS CO.

The Super Speed Warpers produced by Barber-Colman have a winding speed of 900 yards per minute yet these units are also engineered for low and uniform tension to produce a beam in which thread ends are stressed alike.

Specifications for the machines are strict: tubular metal parts must be machined to a fine finish and to precise measurements. They must have high strength and be balanced so that they are capable of withstanding sustained high speeds. ACIPCO tubes **custom-fit** requirements such as these.

Centrifugally Spun ACIPCO tubes have a dense, non-directional grain structure which is easier to machine. Important, too, their **inherent** dimensional stability and concentricity makes dynamic balance easier to attain in finished products.

If your machines or products employ tubes of stainless steel, carbon steels, alloy irons, or special analyses as components, it will pay you to investigate ACIPCO. Call or write for complete information on ACIPCO tube applications in your field. No obligation, of course.

SIZE RANGE: Lengths up to 410″ have been produced to meet modern machinery requirements. OD's from 2.25″ to 50″; wall thicknesses from .25″ to 4″.

ANALYSES: All alloy grades in steel and cast iron, including heat and corrosion resistant stainless steel, plain carbon steel and special analyses.

FINISHED: As cast, rough machined, or finished machined, including honing. Complete welding and machine shop facilities for fabrication.

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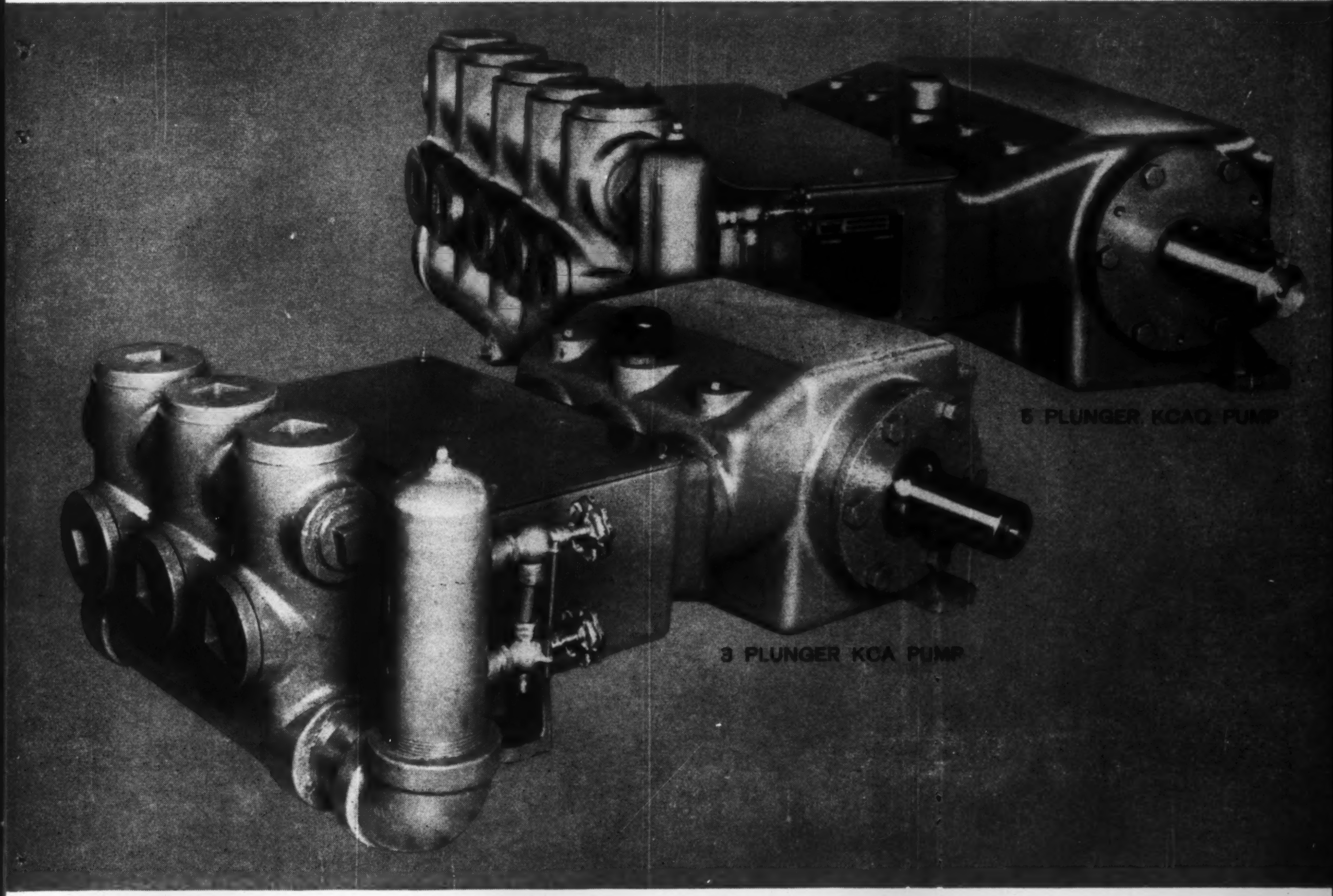
Introducing: 2 NEW HIGH PRESSURE PUMPS AT 2 NEW LOW PRICES



Before you buy a high pressure pump for your hydraulic application, see Worthington's new KCA and KCAQ pumps. You can depend upon these two new pumps to give you highest capacity and most pressure at truly low prices.

These horizontal power pumps save you up to 53% on initial cost. Some of the many applications for the KCA and KCAQ units include hydraulic presses and shears, steel mill roll balance, die casting, boiler feed service, descaling, cleaning and washing, fog spraying, hydrostatic testing, and rifle drilling coolants.

The KCA and KCAQ pumps have 6 outstanding features:

1. **Meets wide range of conditions.** Plunger diameters can be varied from 1¼ to 2½ inches.
2. **Fewer Spares to carry**—Wearing parts interchangeable between KCA and KCAQ pumps.
3. **Many "extras" included as standard** such as solid ceramic or Colmonoy plungers, suction air chamber to minimize noise and pulsation, plunger packing and stuffing box cover.
4. **Flooded suction adequate** because large pipe connections minimize friction. KCAQ has 4″ suction, 3″ discharge on either side. KCA has 3″ suction, 3″ discharge on either side.
5. **Less valve wear** resulting from guided, wing-type valves that are self-grinding. Liberally-sized suction and discharge valves both removable through single top covers.
6. **No shaft deflection problems.** Extra heavy crankshaft has *all* roller bearings.

For complete information, get in touch with your nearby Worthington representative. Or write to Worthington Corporation, Section 32-4, Oil City, Pa. In Canada: Worthington (Canada) Ltd., Brantford, Ont.

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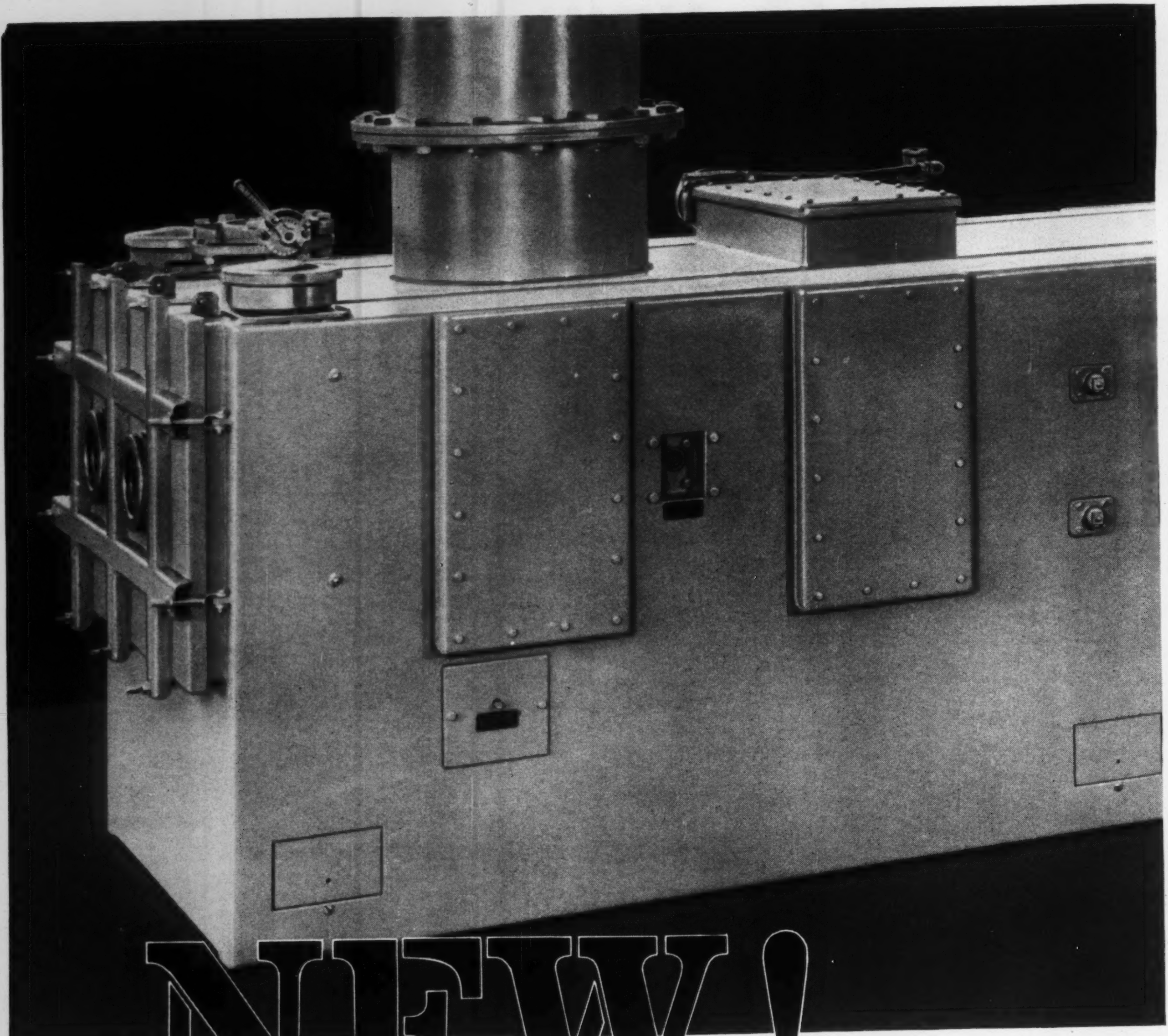

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A COMPLETE LINE OF

VOLUMETRIC

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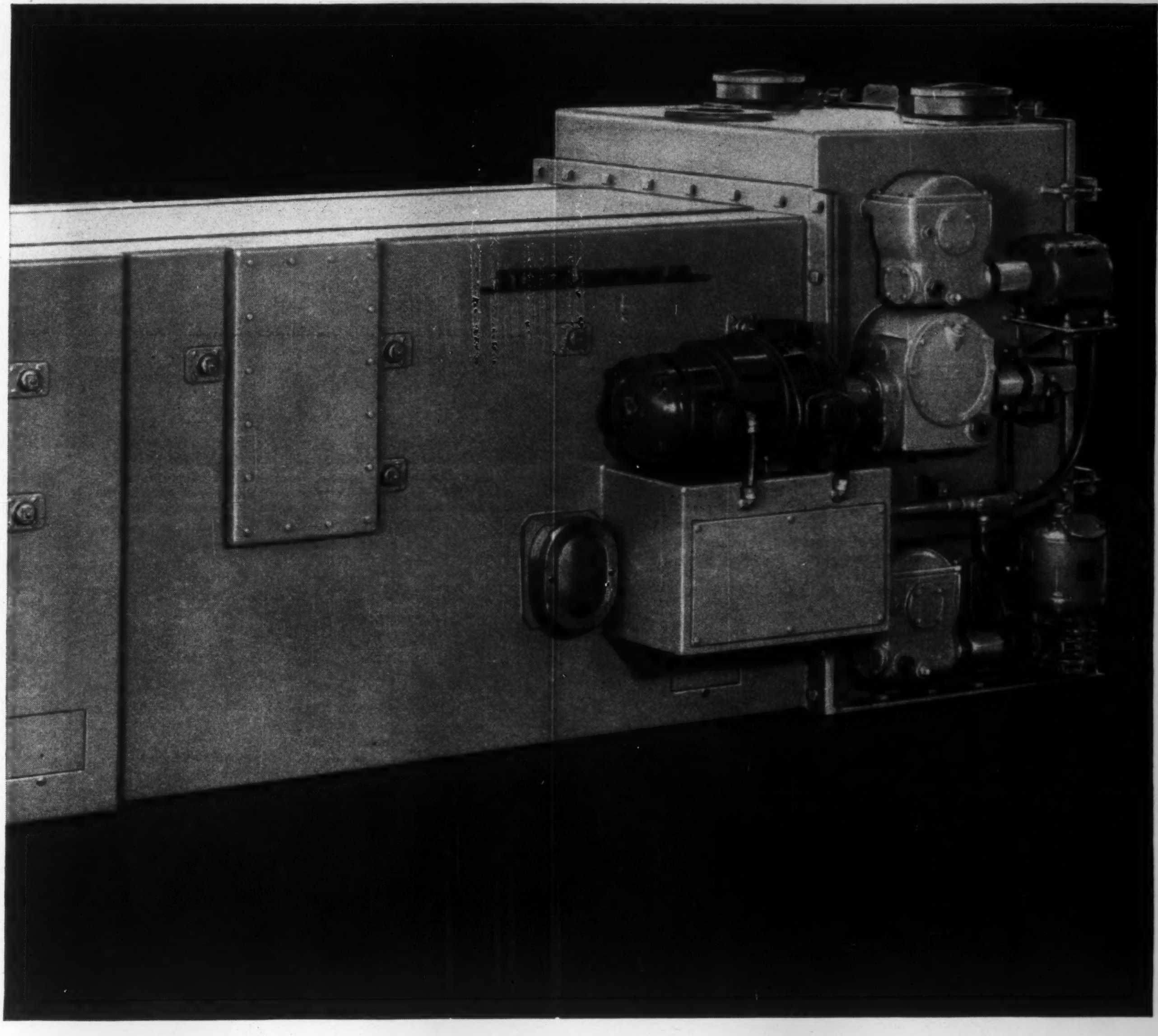

To assure more reliable coal flow to pulverizers and cyclone burners, Stock Equipment Company has developed a complete line of Volumetric Feeders. The unrestricted 24″ width of coal stream is only one feature contributing to completely satisfactory operation even with fine, wet, sticky coal and with coal containing frozen or oversized pieces. The endless rubber belt used in the S-E-Co. Volumetric Feeder together with perfection in mechanical details provides long life with low maintenance.

Include S-E-Co. Volumetric Feeders in your next boiler specification.
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by STOCK Equipment Company
729 HANNA BUILDING • CLEVELAND 15, OHIO

TRIPLE LANE TUBE LAYOUT . . .

what it is and how it IMPROVES CONDENSER OPERATING EFFICIENCY

An informative advertisement from one of the nation's most experienced condenser manufacturers

Steam condenser efficiency depends on water temperature and condition, proper maintenance procedures and many other factors. One of the most important is the design of the condenser itself—and *this* is largely a function of tube sheet design.

Triple Lane Tube Layout, a development of C.H. Wheeler Manufacturing Company of Philadelphia, is making significant contributions to condenser operating efficiencies in public utilities and industrial plants throughout the country. Figure 1 shows a C.H. Wheeler Dual Bank Surface Condenser with Triple Lane Tube Layout.

This tube sheet design permits steam to travel through three separate pathways. As a consequence steam penetrates to all condensing surfaces and utilizes to the fullest extent the condensing capabilities of the steam condenser.

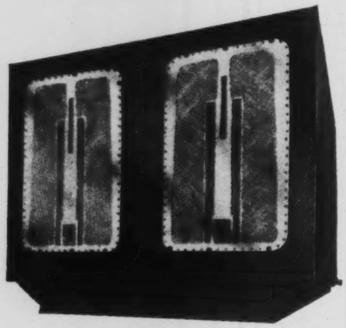


Figure 1: Typical C.H. Wheeler Condenser with Triple Lane Tube Layout.

Central location of the air cooler section, another C.H. Wheeler design feature, also improves steam travel. It reduces the depth of steam penetration and therefore reduces resistance to steam passage, achieving a new low in condenser pressure loss.

How Reverse Flow Improves Condenser Efficiency, Reduces Maintenance

Proper maintenance—keeping tubes and tube sheets free from foreign matter, algae and scale—helps keep condensers operating at peak efficiency. In some cases grass and twigs build up to a point where they would ordinarily have to be shoveled out! It is in such cases that C.H. Wheeler Reverse Flow solves time-consuming, expensive maintenance problems. Here's how it works:

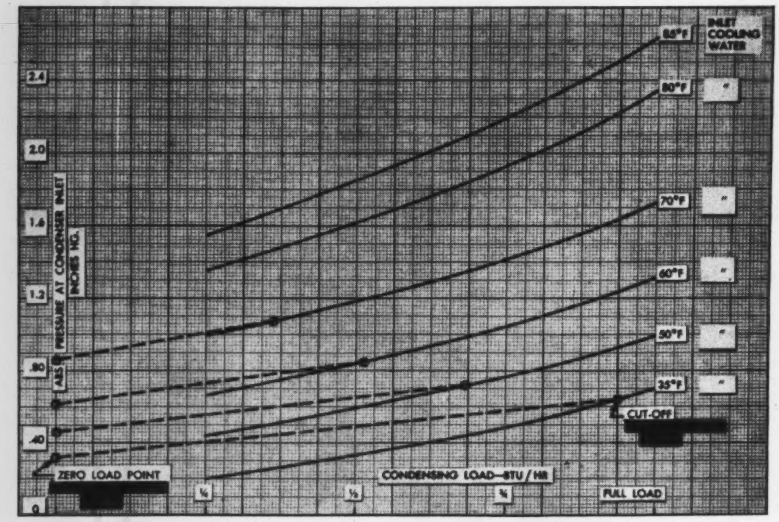


Figure 2: Typical condenser performance curves show how inlet cooling water temperature affects absolute pressure at condenser inlet at varying condensing loads. For a complimentary copy of the 38-page Condenser Handbook from which these curves are taken, write to C.H. Wheeler on your company letterhead.

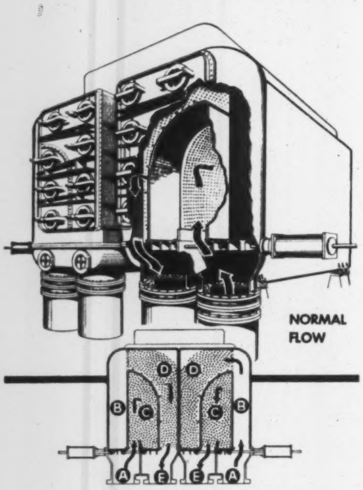


Figure 3: Diagram of C.H. Wheeler Reverse Flow which cleans tubes and sheets during full load operation.

Normal operation is shown on the left in the diagram in Figure 3. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram in Figure 3 shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

Because of more-than-half-a-century of experience in condenser design and maintenance, C.H. Wheeler is unusually well qualified to advise on condenser efficiency and maintenance problems. We invite your inquiry, whether you're concerned with condensers or with circulating and condensate pumps and other auxiliary equipment. A note on your company letterhead will receive prompt attention from us.

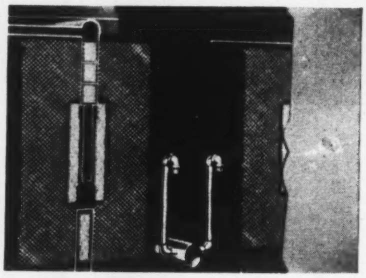


Figure 4: Central location of air cooler section in C.H. Wheeler Condensers reduces depth of steam penetration and therefore lessens resistance to steam passage, achieving a new low in pressure loss in the condenser.

C. H. WHEELER MFG. CO.

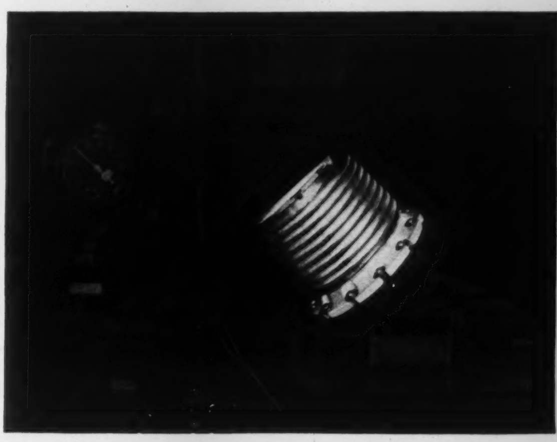
19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

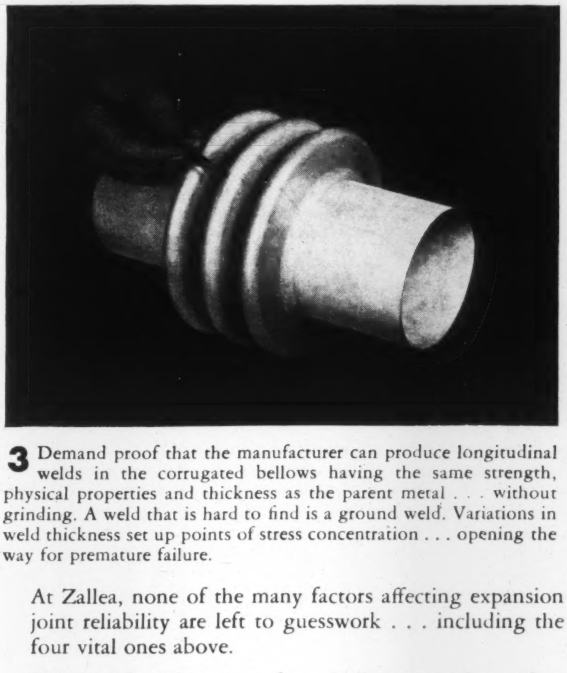
Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components

4 WAYS to get maximum reliability in expansion joints

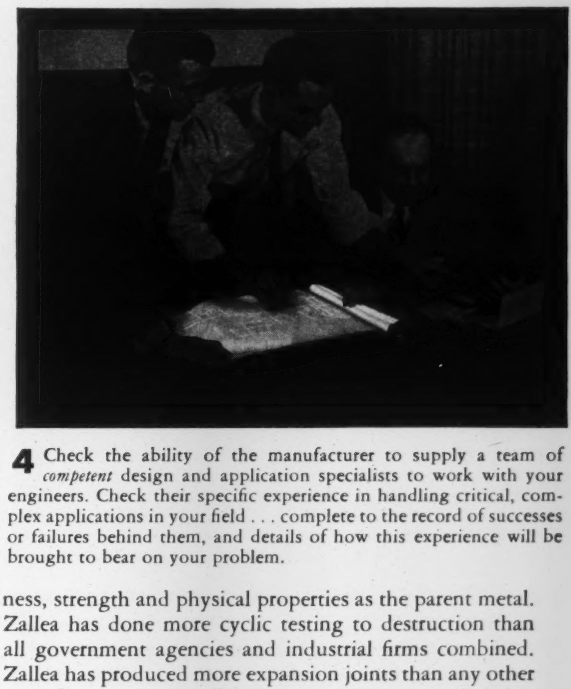
1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.



3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.



4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

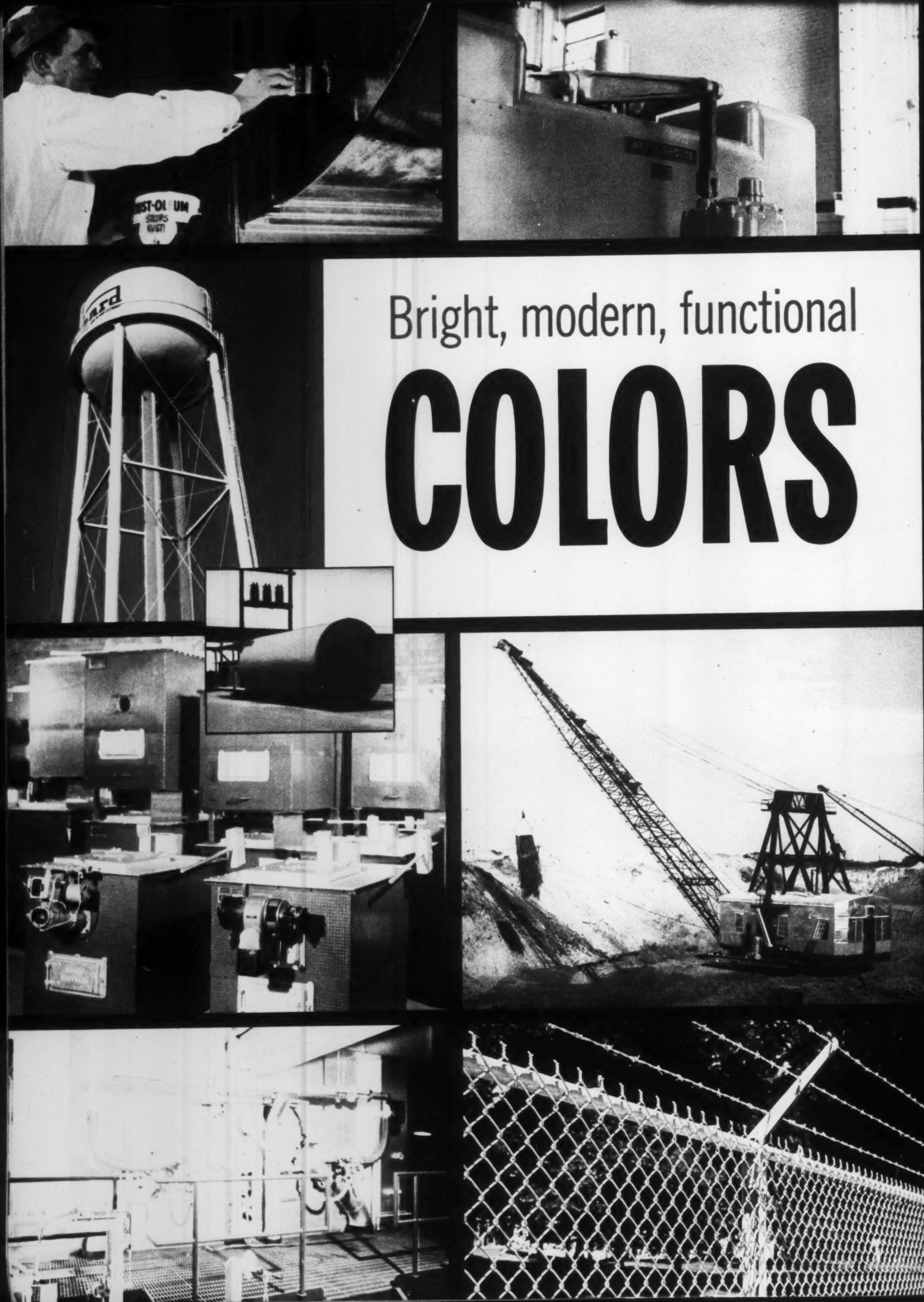
At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea *for maximum reliability*

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints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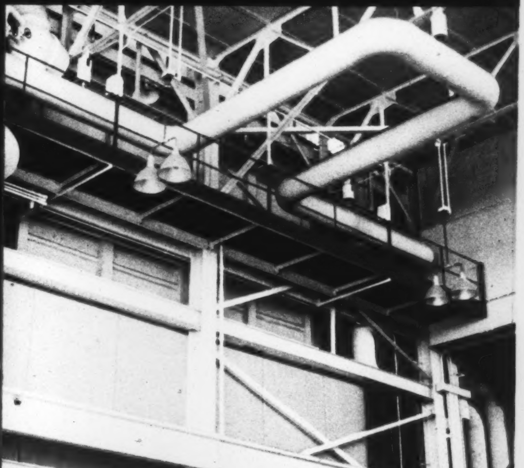
COLORS



...another important **Difference** in the Rust-Oleum System

How many coating manufacturers offer you a *complete system* that Stops Rust—and provides lasting beauty over the years? The Rust-Oleum *System* does just that.

First—apply Rust-Oleum 769 Damp-Proof Red Primer directly over the sound rusted surface, after scraping and wirebrushing to remove rust scale and loose rust. The *specially-processed* fish oil vehicle in the primer penetrates rust to bare metal—merging the rust into the coating—saving costly surface preparations. *Second*—the wide variety of colors in Rust-Oleum finish coatings provides lasting beauty over the primer. Your choice of practically all colors from bright enamels to soft, restful pastels—all formulated for long over-the-years protection.

What is your coating problem? From Heat Resistant, Chemical Resistant, and Machinery Finishes to Heavy-Duty Top Coatings for use indoors and out—Rust-Oleum has the coating to meet your needs and the *system* for lasting beauty. Consult your Rust-Oleum Industrial Distributor . . . he has complete stocks for your use in maintenance, new construction, and remodeling. His experience can serve you well.

A matter of excellence.
Distinctive as your own fingerprint.

RUST-OLEUM®
STOPS RUST!®

SEE OUR CATALOG IN SWEET'S OR WRITE FOR COPY

RUST-OLEUM IS AVAILABLE IN PRACTICALLY ALL COLORS

STOP RUST

with
RUST-OLEUM
769 Damp-Proof Red Primer

Eliminate costly surface preparations and save time, money, and metal. Just brush Rust-Oleum 769 Damp-Proof Red Primer right over the sound rusted surface—after scraping and wirebrushing to remove rust scale and loose rust. You can do this because the **specially processed fish oil vehicle** penetrates rust to bare metal—as proved by radioactive tracing studies.

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Rust-Oleum Corporation
2982 Oakton Street, Evanston, Illinois

Please send me the following at no cost or obligation:

☐ Free test sample of Rust-Oleum 769 Damp-Proof Red Primer for rusted metal surfaces.
☐ Complete literature with applications and color charts.
☐ Information on matching special colors.
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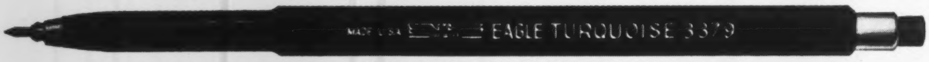
On any drafting material . . .

PAPER
CLOTH
VELLUM
"MYLAR"®

You draw sharper, clearer with Eagle Turquoise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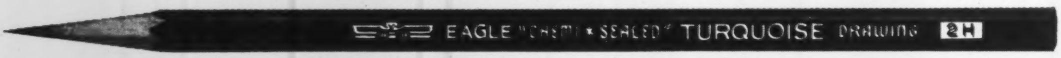
TURQUOISE LEAD HOLDERS hold any TURQUOISE lead (5B to 9H) in a bulldog grip.


EAGLE "CHEMI ✶ SEALED" TURQUOISE DRAWING 2H

TURQUOISE DRAWING PENCILS are made in 17 degrees, 6B to 9H.

EAGLE "CHEMI ✶ SEALED" TURQUOISE DRAWING 2H

TURQUOISE WITH ERASER, in grades 4B to 6H, is increasingly popular as a field tool.

We've run tests on every drafting material made—including some that aren't even on the market yet! On all of them, TURQUOISE consistently out-performs other pencils.

Here's why: the strong TURQUOISE needle-point stays sharp longer. You get the world's cleanest lines—for the world's sharpest reproduction. TURQUOISE'S "electronic" graphite glides more smoothly (without skipping) over every material. And these superior qualities are combined with perfectly uniform grading—pencil after pencil!

So why switch pencils when you switch drafting surfaces? Standardize on Eagle TURQUOISE!

WANT A FREE SAMPLE? Write for a TURQUOISE lead, pencil, or pencil-with-eraser in the degree you'd like to test on your favorite drafting material. Eagle Pencil Company, Danbury, Conn.

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Capacities to 15000 EDR–To 23 GPM

- Low NPSH ... smooth ultra-quiet operation ... impeller design with curved inlet blade tips that minimize shock loss as the liquid enters the impeller.
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- Simplex or Duplex units.

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VERTICAL UNITS

Capacities to
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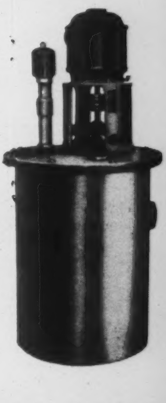
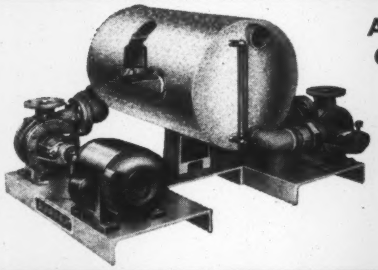
Ideal for applications where return is extremely low or below floor level.





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Capacities to 100,000 EDR
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With automatic range adjustment, equalized pressure, and the many advantageous features of APCO Turbine Type Pumps

TYPE C HEAVY DUTY UNITS
Capacities to 150,000 EDR
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For high capacity or heavy duty applications. Packing Boxes on pumps optional when desired.

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POWELL

one quick call to Powell will fill most valve needs *from "in-stock" supply*

For all industrial flow control requirements—whether handling water, oil, gas, steam, or corrosive fluids—Powell makes the *right* valve—in the *right* size—of the *right* metal or alloy.

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Key-Kast Elbows have cast steel walls of a uniform thickness approximately 15% heavier than the required minimum thickness of pipe walls of the same I.D. For extra highly stressed line sections, the wall thickness and strength can be increased as much as desired — without sacrificing uniformity.

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Key-Kast Fittings can handle **any** piping job. Specify them. You'll get outstanding service.

KEY-KAST® – the only cast elbows that meet all requirements for strength and flexibility

KEY-KAST *Uniform Wall* Alloy Steel Welding Elbows will give you outstanding service in any high pressure, high temperature alloy piping application. Only Key-Kast Elbows have cast steel walls of uniform thickness and strength — the most important factor in selecting the right fittings for your job.

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Call your Key-Kast representative for prompt, experienced service in selecting the Key-Kast Fitting best for you. Available in all standard shapes, sizes and schedules . . . or specially designed to meet specific conditions of pressure, temperature and lading. *W-K-M Division of ACF Industries, Incorporated, P. O. Box 2117, Houston, Texas.*

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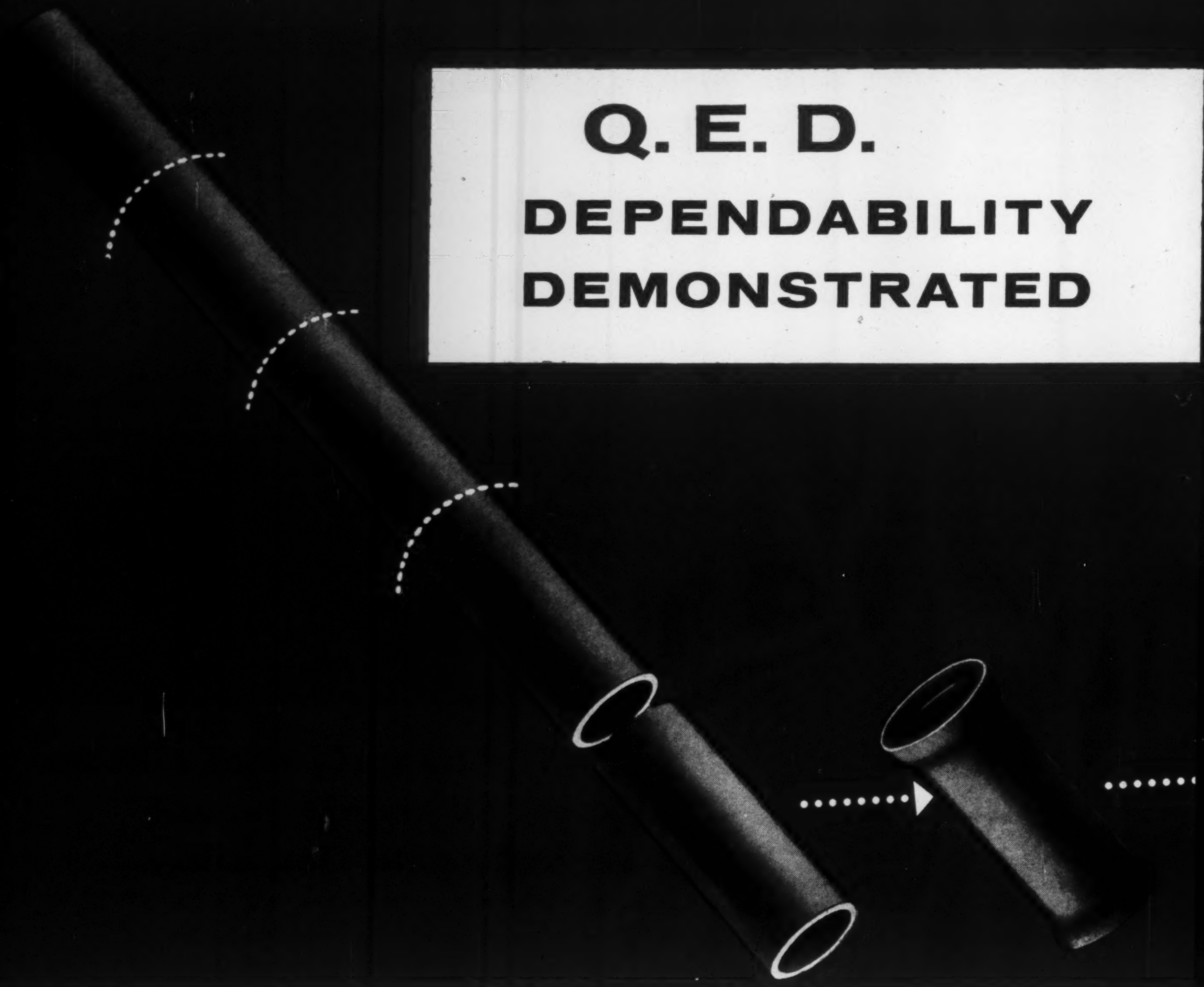

Now . . . basic characteristics of Metal Mold Centrifugal Casting contribute to the reliability of new Lacrosse Missile

THE ARMY'S LACROSSE MISSILE

U. S. Pipe supplies the barrel nozzle in a Cr-Mo-V low alloy steel analysis, heat treated to the following minimums: 95,000 psi tensile strength, 75,000 psi yield strength, and 10% elongation. This alloy is specifically designed to meet exacting military specifications. Various other analyses in carbon, alloy and stainless steel are produced.

Centrifugal casting, a direct production approach to quality, is now finding new and increasingly useful applications in rocketry and missile engineering.

U.S. Pipe, for example, supplies the alloy steel barrel nozzles for the Army's Lacrosse Missile as semi-finished, partially hot-forged lengths. These production pieces are being supplied to The Martin Company, Orlando, Florida — prime contractor for the Lacrosse, and to Parish Pressed Steel, Reading, Pennsylvania — subcontractor to The Martin Company. The contractors then finish machine them for assembly in the propulsion units.

Centrifugal casting offers ordnance design engineers several outstanding advantages:

1. Versatility. Many different alloy and stainless steel analyses, sizes and contours can be produced starting with a hollow billet.

2. Dependability. Years of experience in producing metal mold centrifugal castings assures high quality and reproducibility.

3. Economy. Maximum utilization of the *right* material produced with a minimum of processing to achieve overall efficiency.

Can these basic qualities meet the requirements and lower the cost of your material needs? Write today and outline your particular problem.

Size Range & Composition Flexibility
Outside Diameter — 6" to 60" • Wall Thickness — ⅜" and up
Length — Up to 25'
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"BUFFALO" TYPE "E" BLOWERS AND EXHAUSTERS

Wherever you need constant air pressures up to 5500 cfm, these dependable "Buffalo" Blowers will do the job most efficiently and economically. Compact, ruggedly-built, direct-connected "Buffalo" Type "E" Blowers and Exhausters are available in eight sizes. Pressures up to 2 lbs. mean you can choose the units exactly suited to your needs.

Various special features are available, including flanged inlet, flanged outlet, stuffing box around the shaft for gas-tightness. For corrosive fume handling, housings can be coated with Bisonite or Heresite. Housings may also be cast of special metals. Stainless steel, Everdur, brass or aluminum wheels are available. Used in multiple, these units are more flexible and economical than a single large blower.

For full information on "Buffalo" Type "E" Blowers and Exhausters, contact your "Buffalo" engineering representative—or write us for Bulletin FMB-935. Other units suitable for higher pressures are the type RE and type CB blowers.

"Buffalo"

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Buffalo, N. Y.
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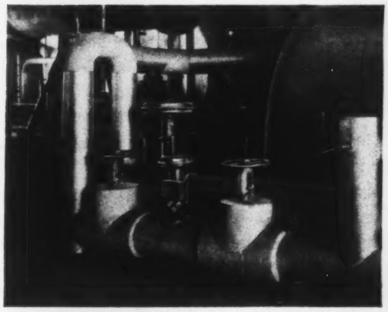
VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

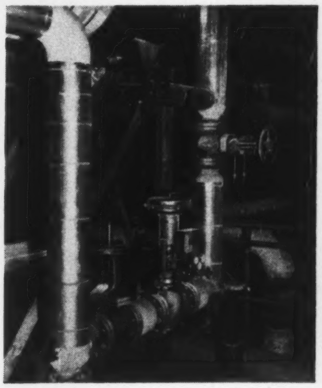
Super 70's "On Stream"

General Plant View.

Clinch River Plant, Units 1 & 2



High Pressure Heater Drain To Deaerator.



Number 4 Heater Level Control Valve.

Highlighting the vast power expansion program of the American Electric Power System, two additional 225,000 KW steam-electric generating stations were recently put on the line by the Appalachian Power Company.

In these fully automatic reheat stations, BS&B Super 70 Control Valves, together with BS&B Liquid Level, Pressure and Temperature Controllers, are employed in heater drain and other auxiliary control systems.

Engineering service, including preliminary engineering studies, multi-load analysis and start-up assistance were provided with BS&B Controls in the Clinch River Plant to assure unit responsibility as well as efficient and dependable system performance.

In the two world's-largest forthcoming 450,000 KW super-critical once-through stations, BS&B Controls will again render proud service to the Power Industry through the American Electric Power System.

BLACK, SIVALLS & BRYSON, INC.
Controls Division, Dept. 4-FQ9
7500 East 12th Street • Kansas City 26, Missouri

SUPER
BS&B
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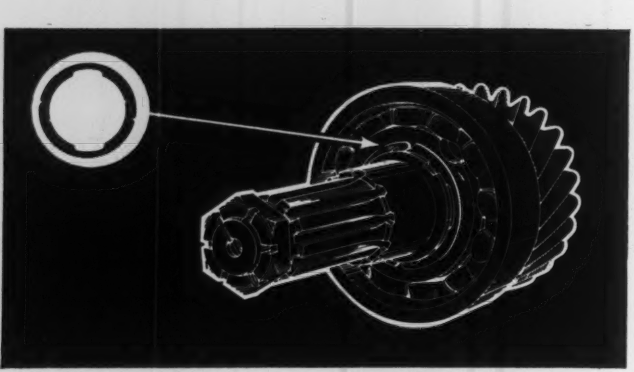
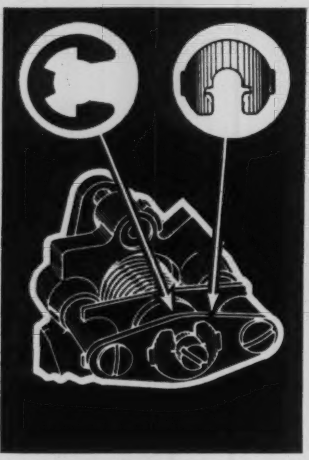
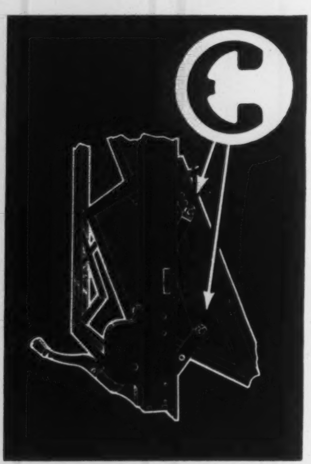


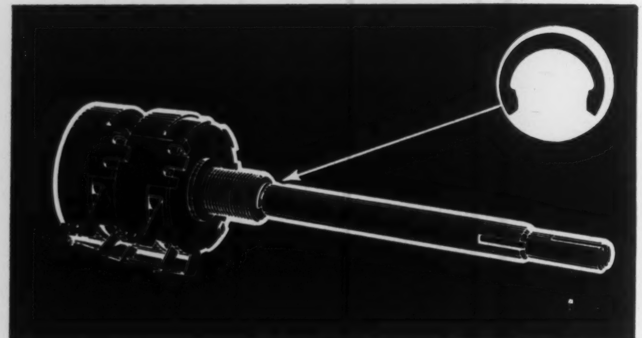
Heavy duty transmission design simplified. On this dual axle drive for trucks, a Truarc Series 5107 ring locks bearing on drive shaft. Interlocking ring design won't dislodge under heavy torque . . . is also recommended for high rpm. applications.



Rings replace machined shoulders, collars, set screws. That's what original design of this pneumatic temperature transmitter called for. Series 5139 Prong-Lock® ring with bowed design compensates for accumulated tolerances in parts, provides sufficient friction to prevent rotation under vibration. At the same time two Waldes E-rings position and lock adjustment screw to face plate.



Reinforced aluminum ring gives design advantages on louver windows. Waldes Truarc Series 5144 reinforced rings of aluminum secure hinge pins, eliminate costly riveting in linkage of louver type window. Ring design provides large bearing shoulder. Reinforced construction has 5 times the gripping strength of standard E-ring construction, allows use of non-corrosive aluminum.



Ring acts as locking shoulder. Holding the threaded ferrule on this potentiometer shaft is a Truarc Series 5103 Crescent® ring. Crescent ring design with low shoulder provides ample clearance for assembly of panel locknut. It is less costly than a machined shoulder, more effective, quicker to install, easier to remove than the C washer previously used.

Designing with radially assembled Waldes Truarc retaining rings

solve varied product design problems—save machining, materials, parts and labor

Radially assembled retaining rings, which snap onto a shaft at right angles to its axis, greatly extend the range of products on which retaining rings may be used to simplify design and save parts or labor costs.

For example, rings for radial assembly can be used in applications where it is impossible to install a ring axially over the end of a shaft. Certain types are designed to accommodate shafts of relatively wide tolerances. Others described below may be used to provide a sizeable shoulder on a shaft.

The four applications shown here provide an indication of the wide range of products using radially assembled rings. The rings themselves are basic Truarc types each having specific design features. The high shoulder of one provides a large bearing surface on small diameter shafts; the low shoulder of another is ideal where clearance is limited. A third has an interlocking design which prevents it from being dislodged under torque or high rpm. A fourth can be used against rotating parts at the same time it provides spring tension.

These are but four of Truarc's fifty functionally different types of retaining rings with up to 97 sizes within a single type, six metal specifications and thirteen different finishes. Special hand, magazine, and semi-automatic applicators as well as grooving tools are also available to speed production. The entire line, together with over 70 typical applications, is described and illustrated in the new catalog RR10-58—yours for the asking. And call on us for design assistance on your specific project . . . a Waldes Truarc engineer will be glad to help. Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.

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WALDES
TRUARC®
RETAINING RINGS
Waldes Kohinoor Inc., Long Island City 1, N. Y.

TRUARC RETAINING RINGS . . . THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS

AT LEFT: Installing a 60,000 lbs/hr unit in a brewery

ABOVE: A battery of 125,000 lbs/hr units in a chemical plant

CUSTOM *Steam* GENERATORS by Vogt

Vogt engineering advances can save you money if you have a steam generating problem. Custom-built installations shown, are engineered to assure efficient, dependable steam generation for power, process and heating. Our engineering staff is available to give effective help in the solution of steam generating problems peculiar to a wide variety of operating conditions. Address Dept. 24A-BM.

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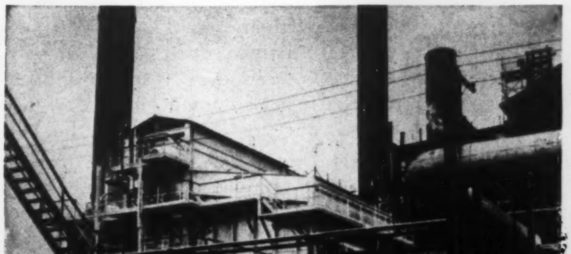
HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati



This 400,000 lbs/hr unit is installed in a leading petroleum refinery

Three 40,000 lbs/hr units serve a medical center

Save hours of searching through equipment catalogs . . . call in American-Standard!

Your American-Standard* Industrial Division representative can usually put his finger on what you're looking for in a hurry. He knows his products and what they can (and can't) do.

Your local Industrial Division man is a seasoned graduate engineer — one who's logged a lot of experience in many fields. He speaks your language. And he's backed by the combined American Blower, Ross, and Kewanee product lines. You talk to one man about air conditioning and refrigeration, heating, air handling, heat transfer, mechanical draft, dust collection, and fluid drives. Gain one-source responsibility for quality and performance in equipment that is designed, engineered, and manufactured to work together.

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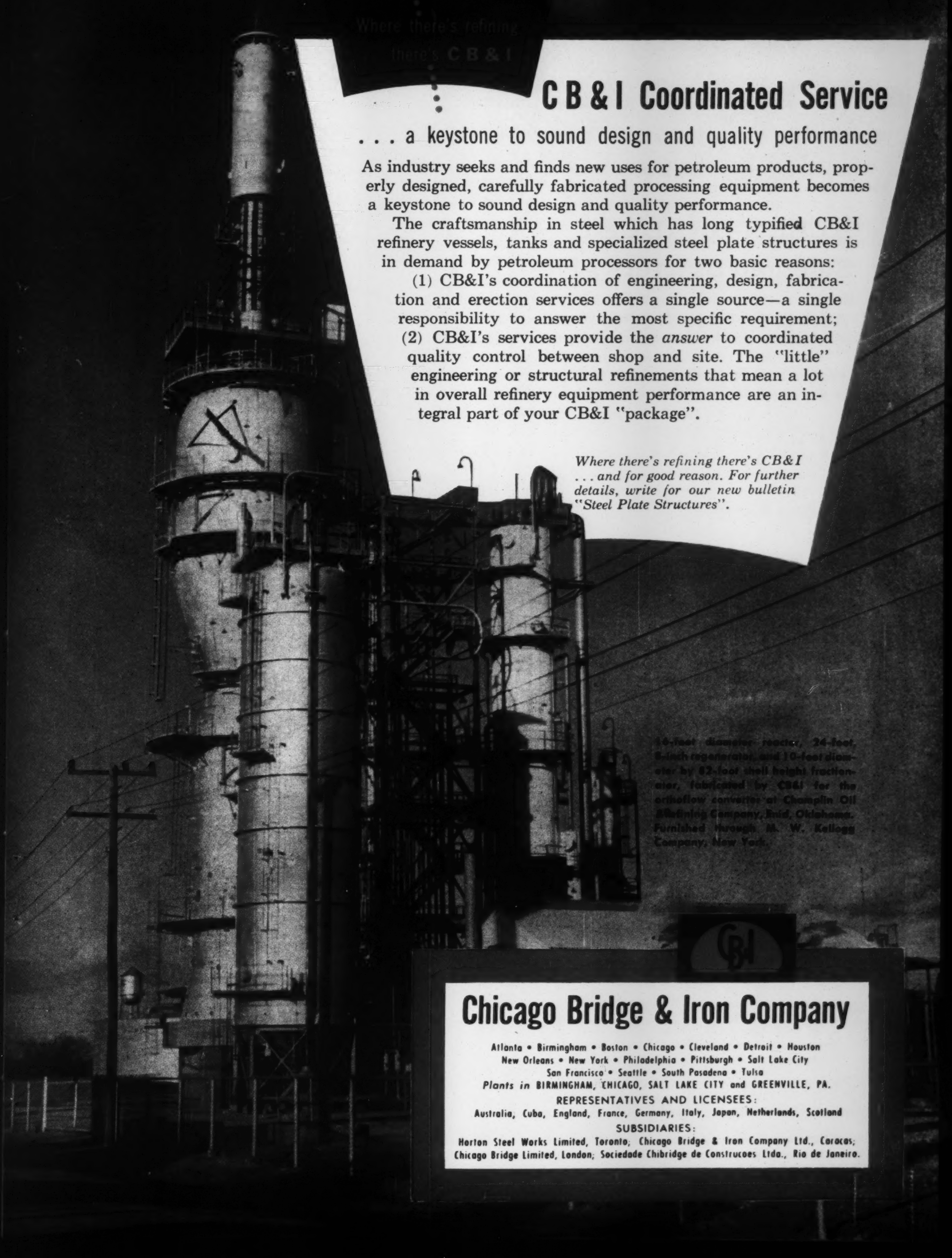

C B & I Coordinated Service

. . . a keystone to sound design and quality performance

As industry seeks and finds new uses for petroleum products, properly designed, carefully fabricated processing equipment becomes a keystone to sound design and quality performance.

The craftsmanship in steel which has long typified CB&I refinery vessels, tanks and specialized steel plate structures is in demand by petroleum processors for two basic reasons:

(1) CB&I's coordination of engineering, design, fabrication and erection services offers a single source—a single responsibility to answer the most specific requirement;
(2) CB&I's services provide the *answer* to coordinated quality control between shop and site. The "little" engineering or structural refinements that mean a lot in overall refinery equipment performance are an integral part of your CB&I "package".

Where there's refining there's CB&I . . . and for good reason. For further details, write for our new bulletin "Steel Plate Structures".

16-foot diameter reactor, 24-foot, 8-inch regenerator, and 10-foot diameter by 82-foot shell height fractionator, fabricated by CB&I for the orthoflow converter at Champlin Oil Refining Company, Enid, Oklahoma. Furnished through M. W. Kellogg Company, New York.

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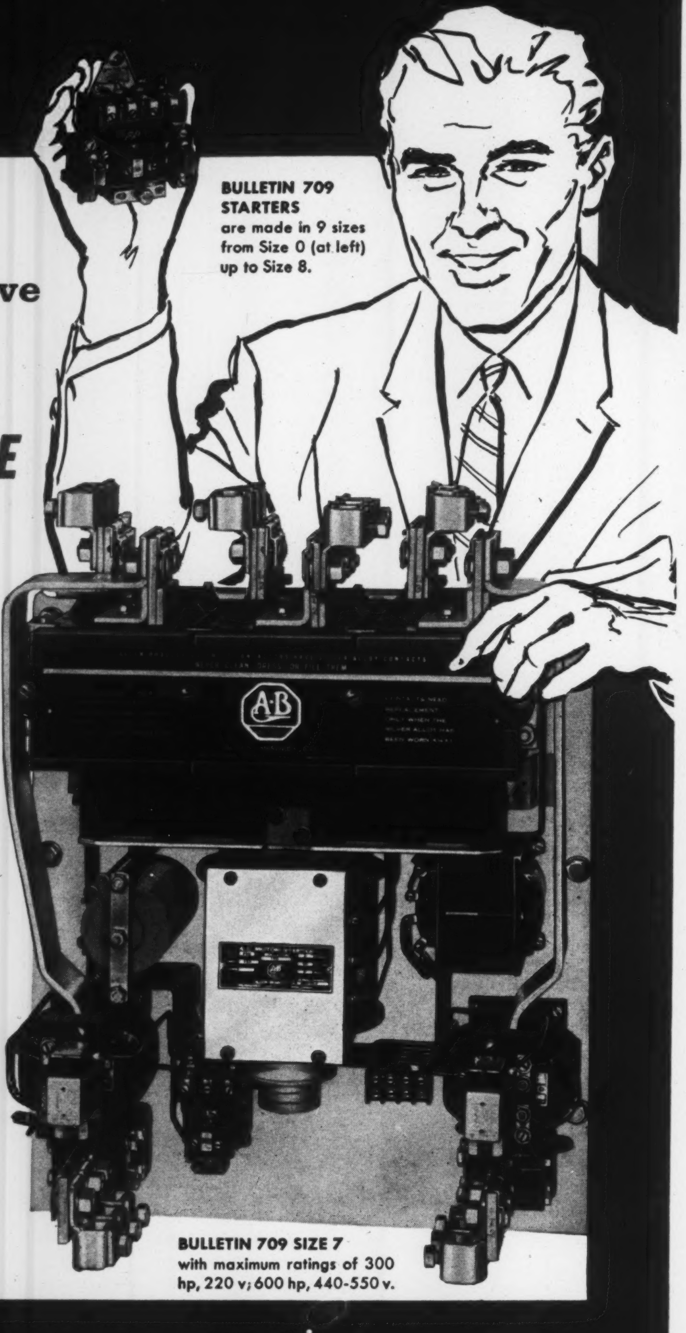
ALLEN-BRADLEY
Solenoid Starters give

MORE MILLIONS OF TROUBLE FREE OPERATIONS

. . . and for good reasons



BULLETIN 709 STARTERS are made in 9 sizes from Size 0 (at left) up to Size 8.

BULLETIN 709 SIZE 7 with maximum ratings of 300 hp, 220 v; 600 hp, 440-550 v.

- **ONE MOVING PART**
  With this simple solenoid design, there's virtually nothing to go wrong—all trouble-causing bearings, pivots, and flexible jumpers have been eliminated.

- **DOUBLE BREAK, SILVER ALLOY CONTACTS**
  Allen-Bradley silver alloy contacts never require maintenance. They are always in perfect operating condition . . . and remain so until completely worn away.

- **SIMPLE UP-AND-DOWN MOTION**
  The virtually frictionless, straight line vertical motion provides uniform contact pressure at all times—and assures consistent, rapid operation of the contactor.

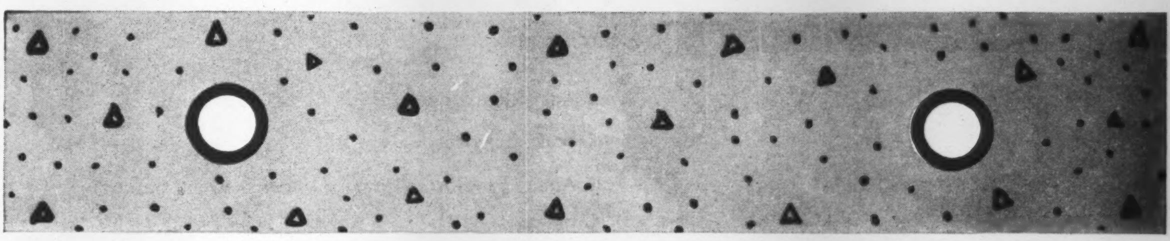
- **RELIABLE OVERLOAD PROTECTION**
  All A-B starters are equipped with two permanently accurate and reliable overload relays that protect motors against "burnouts." Three overload relays can be furnished.

ALLEN-BRADLEY

Allen-Bradley Co., 1326 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

QUALITY MOTOR CONTROL

4-D WROUGHT IRON PIPE



FOR SNOW MELTING AND RADIANT HEATING SYSTEMS

PROPOSAL FOR HIGH STRENGTH, CORROSION-RESISTANT INSTALLATIONS

New 4-D Wrought Iron has increased corrosion-resistance, improved mechanical and physical properties. It was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate.

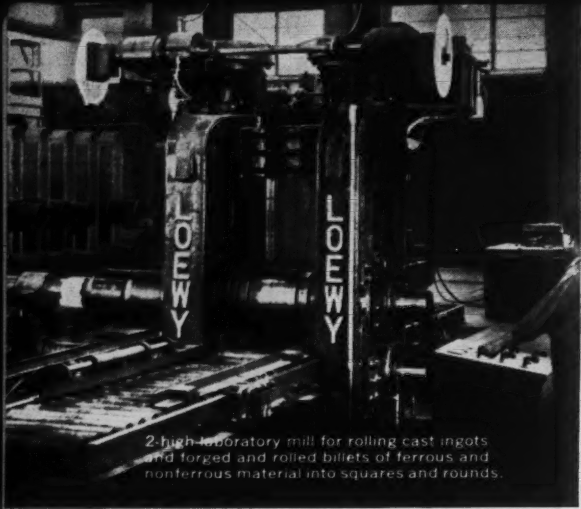
Write for new 4-D Wrought Iron literature and specific technical information: A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

PIPE: THE MOST IMPORTANT SINGLE COMPONENT—Pipe for snow melting and radiant heating systems *must* resist corrosion. It is only accessible for repairs at considerable cost and inconvenience. Any leaks that might result are frequently difficult to locate with any accuracy. It is also virtually impossible to avoid some rough handling during the course of fabricating and installing such systems. So, strength is another piping must.

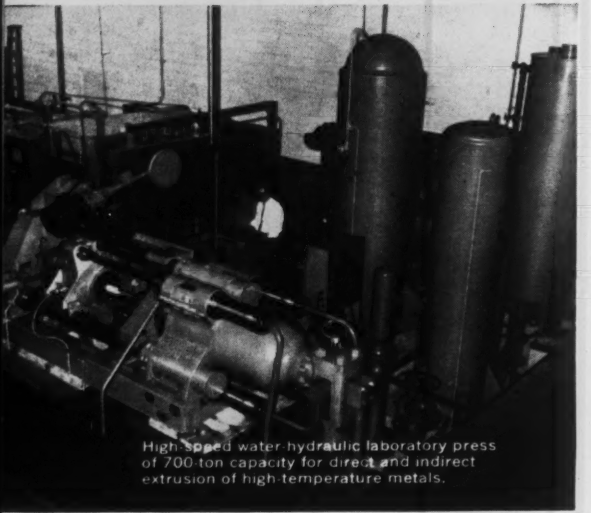
EXPANSION COEFFICIENTS AND WORKABILITY—Pipe is exposed to wide temperature ranges in these services. So there's always the possibility of unequal expansion damaging surrounding material. The coefficients of 4-D Wrought Iron and concrete are identical. This minimizes the possibility of concrete cracking due to thermal expansion. Additional advantages of 4-D are: good bending properties and the sound, durable welds that can be obtained as a result of its self-fluxing action.

SUITABILITY OF 4-D WROUGHT IRON—4-D Wrought Iron is corrosion-resistant, strong, compatible with structural materials over wide temperature ranges, and easy to fabricate. There is *no* "or equal." Historically, the *first* snow melting system in the U.S. was Wrought Iron: designed 34 years ago for Rochester Gas & Electric Corporation, Rochester, N. Y. No failures, ever. The *first* radiant heating system in the U.S. was likewise Wrought Iron: designed in 1938 for Frank Lloyd Wright's famed S. C. Johnson & Son Office Building in Racine, Wisconsin.

BYERS 4-D WROUGHT IRON



2-high laboratory mill for rolling cast ingots and forged and rolled billets of ferrous and nonferrous material into squares and rounds.



High-speed water-hydraulic laboratory press of 700-ton capacity for direct and indirect extrusion of high-temperature metals.

High-speed universal laboratory press of 500-ton capacity with hydraulic cushion. This press is designed for extrusion, drawing, forging and other forming operations.

Loewy laboratory presses and mills offer extraordinary flexibility

EXPERIMENTAL METALLURGY and pilot production with ferrous and nonferrous metals of unlimited variety, under trying and sometimes unknown conditions, demand presses and rolling mills of great flexibility. Consider these features of Loewy research equipment:

- Adaptability to a large variety of forming methods
- Wide range of speeds
- Ability to withstand sudden changes of temperature
- Provision for dealing with the heavy reductions and eccentric stresses caused by uneven shapes and contours
- Production to close tolerances, regardless of heat expansion and atmospheric conditions

All of those capabilities will be found in Loewy-Hydropress laboratory equipment for rolling, extruding, open forging, die-forging, compacting, drawing and rubber-pad forming. Many press-forming operations can sometimes be carried out on the same Loewy machine with but little adjustment.

Loewy specializes in such versatile forming tools for all types of low and high-carbon steels, high-temperature alloy steels, stainless steel, beryllium, zirconium, titanium and other light metals. While this equipment is designed basically for research and development, all features normally found on Loewy production machines can be incorporated.

Industrial and governmental laboratories, universities, foundations and atomic research centers turn to Loewy-Hydropress for metallurgical research equipment designed to their individual purposes.

For specific information or descriptive literature, write to Dept. F-9.

Loewy-Hydropress Division
BALDWIN · LIMA · HAMILTON
111 FIFTH AVENUE, NEW YORK 3, N.Y. Rolling mills • Hydraulic machinery • Industrial engineering

BALDWIN
BLH
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In Economizers

cast iron LASTS...

steel—simply doesn't

Here are 7 advantages of the new Green Cast Iron Extended Surface Economizer:

1. Lasts longer.
2. Requires less space.
3. Has lower draft loss.
4. Is more corrosion-resistant.
5. Is more erosion-resistant.
6. Withstands lower feed-water temperature.
7. Costs less.

★ For replacement of present steel tubes or on new boiler installations.

Green

SAVE MONEY WITH GREEN
CAST IRON FUEL ECONOMIZERS

THE GREEN FUEL ECONOMIZER CO., INC. **BEACON 3, NEW YORK**

LIFETIME SERVICE BACKS UP OCOTILLO'S NEW LJUNGSTROMS®

Extremely compact and highly efficient, these baskets of heat transfer surfaces are the heart of the Ljungstrom. (The photo below shows one being lifted into position.) Every inch of these baskets is the approximate equivalent of one foot of a standard tubular heat exchanger. The combined surface of the Ocotillo Air Preheaters provides 263,600 sq ft of heating surface.

The new Ocotillo Power Plant, near Tempe, Ariz., employs four Ljungstrom Air Preheaters for its two 835,000 lbs/hr boilers. Dependability is built into these Ljungstroms, from their corrosion-resistance to their double-life reversible elements (shown in the photo above).

But one of the most important reasons why Ocotillo chose Ljungstrom is Lifetime Air Preheater Service. Throughout the life of each unit (units dating from 1923 are still in operation), Air Preheater engineers make regular calls to inspect the units and keep them in top operating condition.

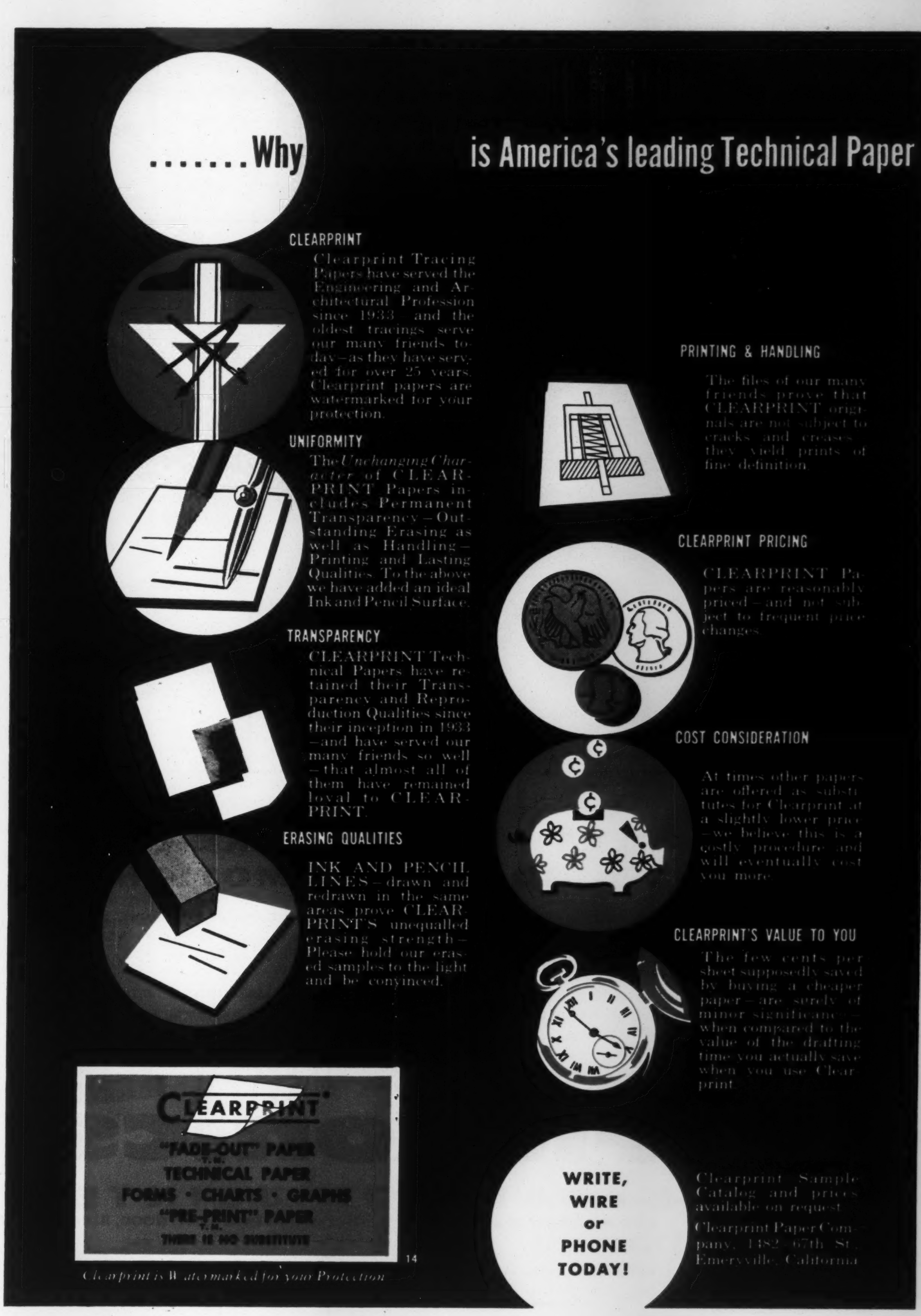
What's more, Air Preheater provides rapid factory service, too. Here's an example: a customer called on a Friday morning requesting immediate shipment of cold-end seals for an Air Preheater. But regular fabrication time would take until the weekend, when no ordinary transportation would be available.

So Air Preheater went to work. Special trucking was arranged. And by a tremendous effort, fabrication was completed *on the same day the order was received* . . . and the customer received the necessary parts *only ten hours after his initial request.*

Fast response to emergencies and regular inspection throughout the life of each Ljungstrom installation are two of the many advantages Air Preheater provides its customers. Another is expert knowledge of boiler and preheater problems—and how to lick them—gained from over 35 years' experience. Perhaps these reasons explain why nine out of ten preheaters sold today are Ljungstroms.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



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The *Unchanging Character* of CLEARPRINT Papers includes Permanent Transparency—Outstanding Erasing as well as Handling—Printing and Lasting Qualities. To the above we have added an ideal Ink and Pencil Surface.

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CLEARPRINT Technical Papers have retained their Transparency and Reproduction Qualities since their inception in 1933—and have served our many friends so well—that almost all of them have remained loyal to CLEARPRINT.

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INK AND PENCIL LINES—drawn and redrawn in the same areas prove CLEARPRINT'S unequalled erasing strength—Please hold our erased samples to the light and be convinced.

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The files of our many friends prove that CLEARPRINT originals are not subject to cracks and creases – they yield prints of fine definition.

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CLEARPRINT Papers are reasonably priced—and not subject to frequent price changes.

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At times other papers are offered as substitutes for Clearprint at a slightly lower price—we believe this is a costly procedure and will eventually cost you more.

CLEARPRINT'S VALUE TO YOU

The few cents per sheet supposedly saved by buying a cheaper paper—are surely of minor significance—when compared to the value of the drafting time you actually save when you use Clearprint.

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FORMS · CHARTS · GRAPHS
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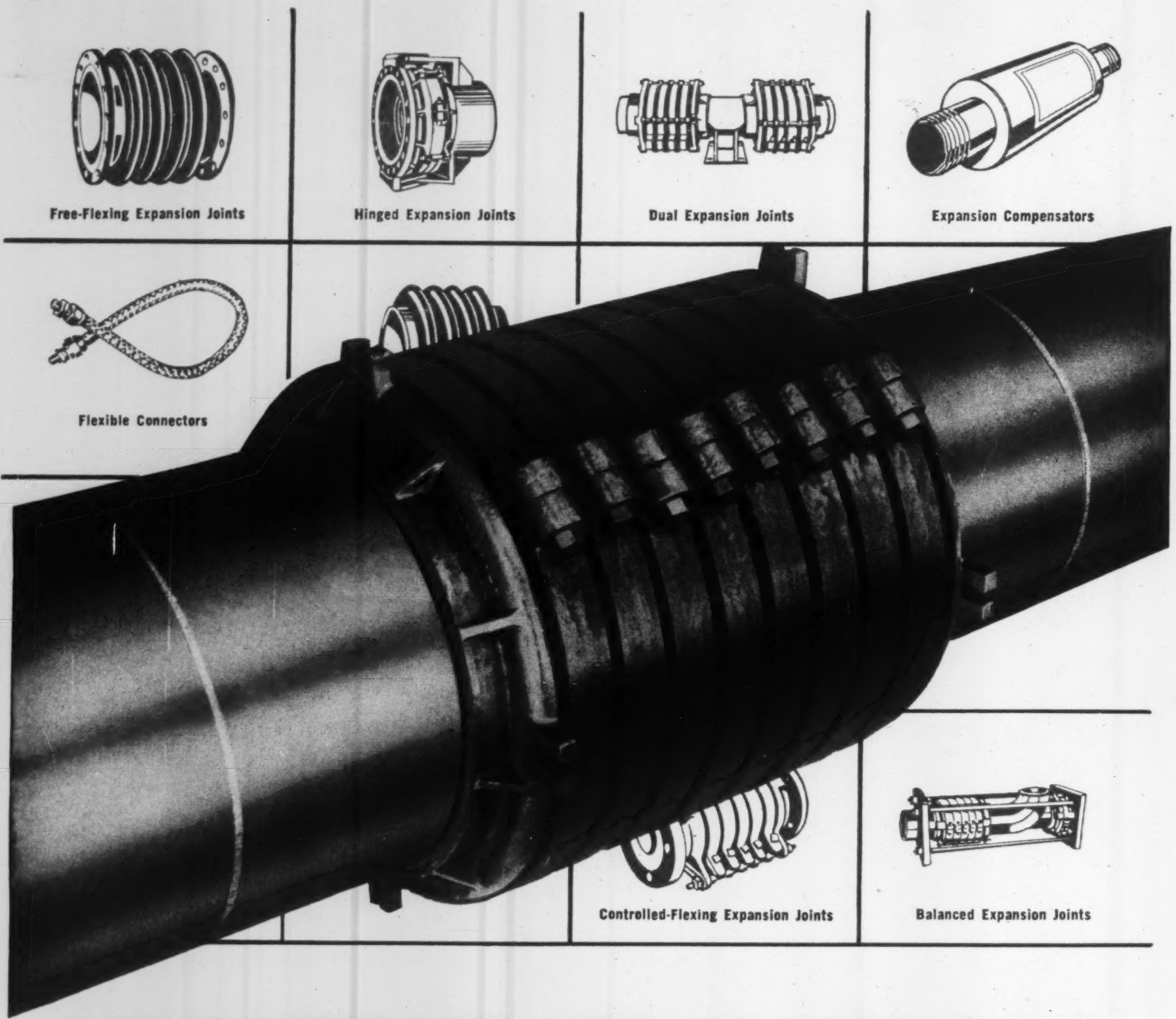
Free-Flexing Expansion Joints
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Flexonics has the equipment – as well as the experience and the skill – to take care of any kind of pipe motion problem. Here's where you benefit from more research . . . more metallurgical care . . . more service . . . and now standard stock sizes for quick delivery from Flexonics warehouses. They all add up to expansion joints that you can *install and forget* – plus expansion compensators, flexible connectors, and the all-new Flexonics pipe alignment guides–to take care of any kind of pipe motion!

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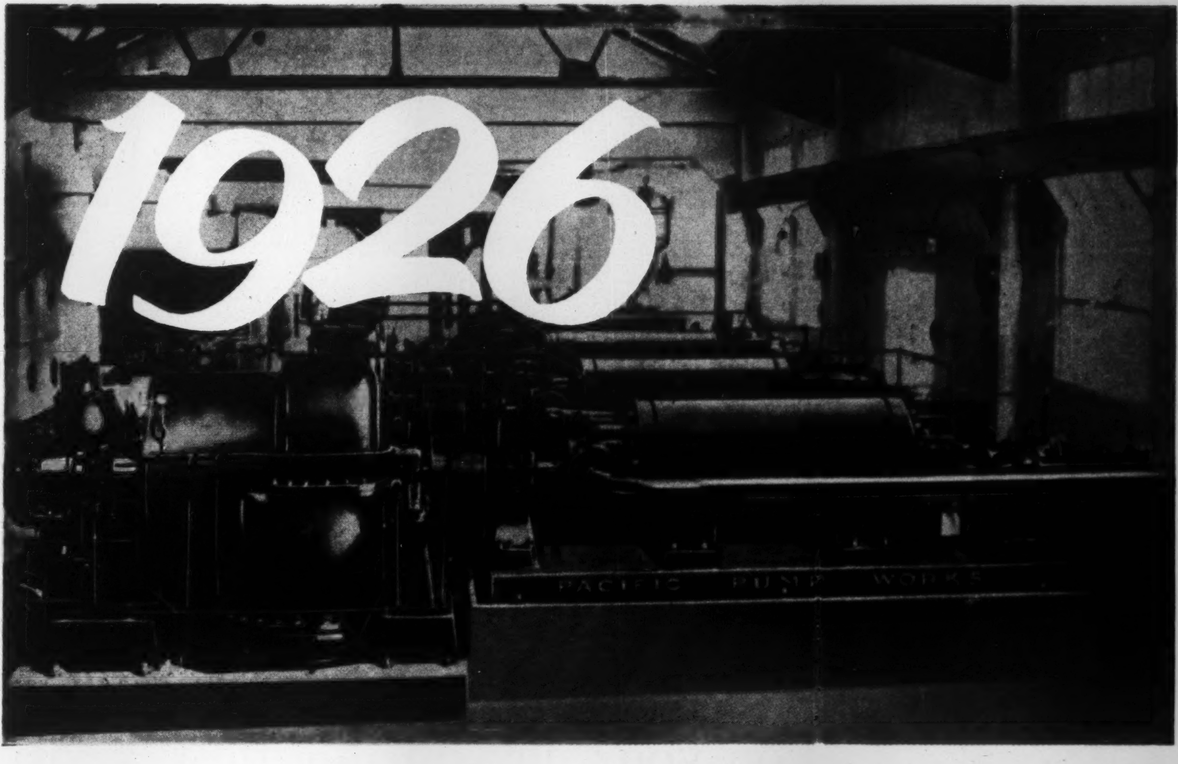
In Canada: Flexonics Corporation of Canada, Limited, Brampton, Ontario



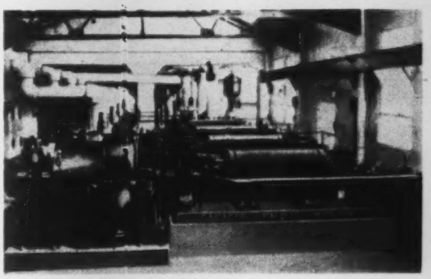
PACIFIC PUMPS

first "FIRST"

The centrifugal pumps designed and built for Pan American Oil Company's new high-pressure cracking process in 1926 was one of the most significant engineering achievements of the Twenties in the refinery processing field. The first of many Pacific Pumps' "FIRSTS", this particular pump was the forerunner of today's greatly improved Pacific centrifugal process pump line. Over the years Pacific has built and installed thousands of vertical and horizontal centrifugal pumps for extreme pressures and temperatures demanded by the petroleum, chemical, petro-chemical and allied industries. In addition, Pacific designs and manufactures boiler feed pumps for the power industry, steam turbo-pumps for the marine and power generation fields, and plunger pumps for oil-well service.

This first Pacific advertisement appeared in several petroleum publications early in 1927 ▶

2000 POUNDS PRESSURE WITH CENTRIFUGAL PUMPS



View of recent installation of four "PACIFIC" Multi-stage Pumps at Pan American Petroleum Company Refinery, Los Angeles. Each Pump delivers a capacity of 400 Gallons Per Minute of Oil against a pressure of 2000 pounds. Pumps are driven by 750 H. P. Steam Turbines. Each Pump weighs nine tons and was required to pass a hydrostatic test of 5000 pounds pressure.

We are prepared to make prompt shipment of Booster Pumps for Pipe Line or High Pressure service. Special Pumps designed for unusual conditions.

PACIFIC PUMP WORKS
350 Bicket Street Huntington Park Los Angeles, Cal.

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PACIFIC®

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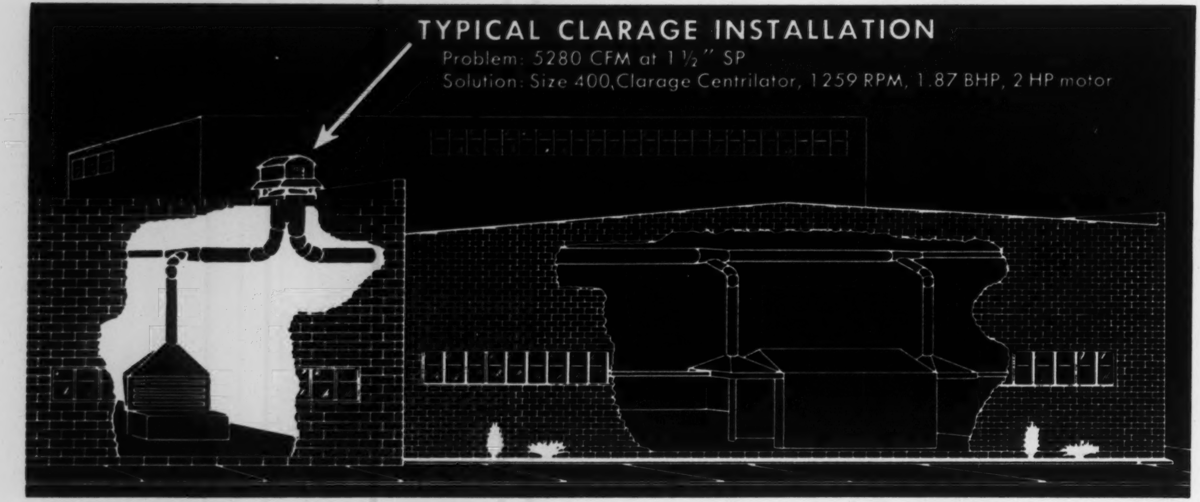
PACIFIC PUMPS
Inc. . . A Division of Dresser Industries, Inc.
HUNTINGTON PARK, CALIFORNIA

IN-1


TYPICAL CLARAGE INSTALLATION
Problem: 5280 CFM at 1½" SP
Solution: Size 400, Clarage Centrilator, 1259 RPM, 1.87 BHP, 2 HP motor

Demonstrating...

how to save space and money on your next air handling jobs

CERTIFIED RATINGS
AMCA

V-belt driven centrifugal type with backwardly inclined blade wheel. 10 sizes. Capacities from 1,500 to 26,500 CFM. (Shown above with weather enclosure and two sides of air apron removed.)

YOURS...ALL YOURS...with the Clarage Centrilator®* power roof ventilator. Handles static resistances to 2". Requires no floor space. Minimum installation cost. Unequalled accessibility. High efficiency for low operating cost. Ideal solution for numerous industrial systems such as the one shown above.

Get full information on the Clarage Centrilator and its exclusive Jet Siphon tm. Air Flow Director feature. Request Bulletin 550 or contact the nearest of our 58 sales engineering offices today. CLARAGE FAN COMPANY.

* Patent applied for

Dependable equipment for making air your servant

CLARAGE

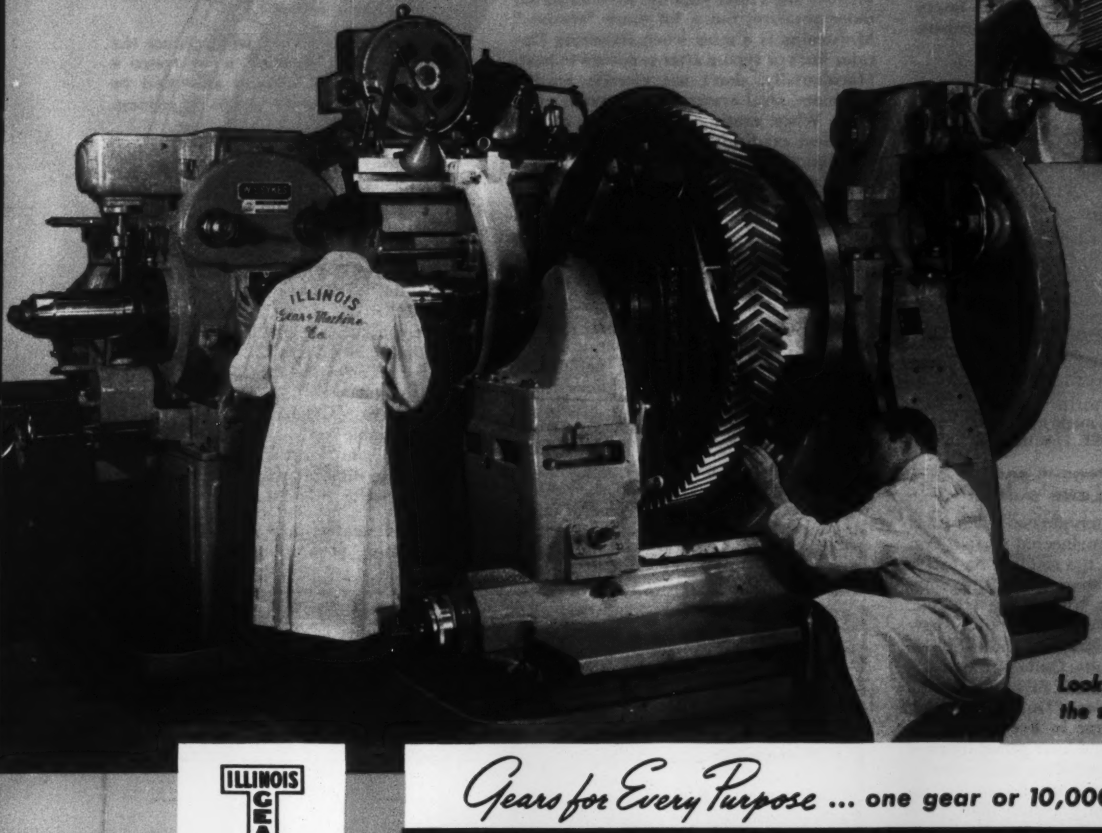
Kalamazoo, Michigan

Here's how Illinois Gear makes sure of Quality in HERRINGBONE GEARS

If you could look down into the ILLINOIS GEAR plants you would see great batteries of the world's most modern gear producing equipment . . . manned by skilled craftsmen who *know* how to operate this equipment.

Typical of what you would see is the precision Herringbone Gear Generator and Testing Equipment, illustrated here. With unmatched facilities such as these ILLINOIS GEAR can produce one gear, ten thousand or more under the most exacting conditions of quality control . . . and meet delivery dates as promised.

If you are not now using ILLINOIS GEARS find out about the gears that can be made in any quantity with quality as the first consideration, as thousands of customers can testify.



Power testing Herringbone Gears under actual operating conditions.

The Herringbone Gear Generator has a 66" diameter and 18" face capacity. Other generators up to 134" diameter, 54" face capacity.

Look for this mark ILLG® *the symbol on finer gears*

ILLINOIS GEARS
Reg. U. S. Pat. Off.

Gears for Every Purpose ... one gear or 10,000 or more

ILLINOIS GEAR & MACHINE COMPANY

2108 NORTH NATCHEZ AVENUE • CHICAGO 35, ILLINOIS

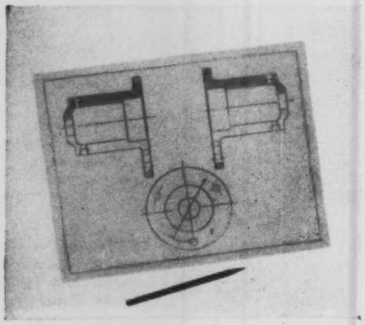
Some Ideas

for your file of practical information on drafting and reproduction from **KEUFFEL & ESSER CO.**

A year of relentless testing has produced a small library of interesting facts about HERCULENE (T.M.) Drafting Film. What follows is a consensus of drafting-room experience with HERCULENE—by K&E and its customers—with some up-to-date recommendations for using it. Take the matter of . . .

Shiny Back vs. Pencil Back

A basic question is: do you need a double-surfaced drafting film? We make HERCULENE Drafting Film both ways, of course—with a single surface (shiny back) and double surface (pencil back). It's our recommendation that you use pencil back HERCULENE only if it's your practice to make basic drawings on one side, changes on the other. For most other uses, shiny back is preferable. (At first, the double-surface film was chosen by many drafting rooms because it lay flatter on the board than shiny back. This is no longer true. K&E research labs have come up with a fully effective anti-curl treatment.) Especially in filing, shiny back HERCULENE presents fewer problems. The clean non-abrasive back won't smudge the face of the sheet underneath, even in a heavy stack of tracings. If you'd like to compare a few sheets, please let us know.



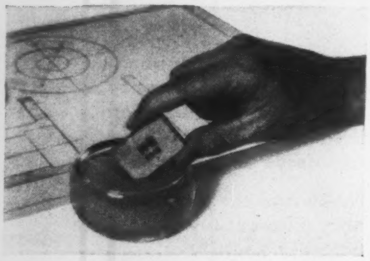
Note sharp clear lines made by Duralar pencil on HERCULENE Drafting Film.

Plastic Pencils and the HERCULENE Surface

Not just a handy catch-phrase, when K&E puts its exclusive "engineered surface" on a drafting material, the result is an exact, uniform tooth for sharp pencil drawing, inking and typing. With HERCULENE Drafting Film, however, an entirely new type of plastic (non-graphite) pencil yields especially good results. Quite a few of our customers have reported favorably on the well-known Staedtler "Duralar" brand. Duralar pencils come in five hardnesses, are non-smudging and have generally good covering power, sharpness and erasability. After about 20 prints, the Duralar lines show up consistently better than those made by a regular pencil, since graphite lines tend to lose density.

Wet That Eraser!

The erasing qualities of HERCULENE Drafting Film are excellent, but (as with the pencils) we've discovered it's a new type of vinyl eraser that gives the best results. Examples of these non-rubber type erasers are the Richard Best "TAD" and the Eberhard Faber "RACE KLEEN"—both available from your K&E dealer. With vinyl erasers, pencil lines whisk off. Even stubborn ink and typing can be removed easily, with no damage to the surface. Here's a tip on how to do this:

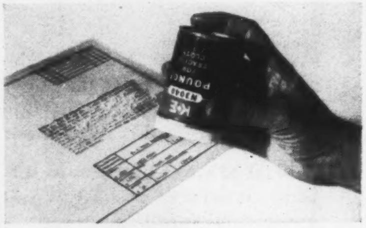


Moisten the eraser slightly. It becomes no more abrasive, but a lot more "erasive." Moistening is a must when removing Duralar lines or typing after exposure to heat. (Incidentally, don't use electric erasing machines, steel erasers or typewriter erasers.) When erasing large areas, certain chemical eradicators work fine too. Our suggestion: use Vythene or a very light application of a denatured alcohol such as Solox, both of which can be applied with a cotton swab or clean cloth.

The Cleaner the Better

HERCULENE Drafting Film was designed for ink work, and its ink take is unexcelled. But like all films, its non-absorbency makes a few preparations advisable. The surface should be cleaned thoroughly before inking. Quickest and most effective way to do this is with the ABC Draftsman's Dry-Clean pad, which will remove finger marks and "traffic film" simply by rubbing the pad over the surface. Pouncing will also work well. A damp cloth is all right for general cleaning, but does not do the best job of preparing the surface for ink.

Inking over graphite pencil lines comes out best when done over light lines, drawn with a harder grade of pencil. A good way to remove excess graphite is to go over the drawing with an ABC pad. Inks vary in their usefulness on HERCULENE. We've tested several, and you're welcome to these results as well, on request.



After Typing, Please Pounce

Typed impressions on HERCULENE Drafting Film are crisp and sharp, but may take a while to dry because the film's surface doesn't "swallow" ink readily. A light pouncing right after typing will dry the ink and fix the lines—giving you uniform permanent contrast.

A new typewriter ribbon will produce the best impressions. At K&E we've tested a healthy variety of ribbons and we'd be pleased to send you the results on request.

Outstanding Advantages Proved in Tests

We're pleasantly amazed at the short time it took for HERCULENE Drafting Film to become an accepted "staple"—along with ALBANENE® Tracing Paper and PHOENIX® Tracing Cloth. Actually, it's a rare drafting room by now that has *not* tested HERCULENE during its first year on the market. The findings: All properties considered, HERCULENE stands up better than any other drafting film. It has great resistance to heat, aging and abuse. Its exclusive "engineered surface" plus its tough, durable Mylar® base provide superior pencil and ink take, fine erasability, remarkable dimensional stability...a combination we're proud to call unbeatable!

The K&E dealer near you has HERCULENE now. Stop in and see him.

KEUFFEL & ESSER CO., Dept. ME-9, Hoboken, N. J.

Please send further information about HERCULENE Drafting Film. I'd like samples too.

Name & Title ______________________

Company & Address ______________________

____

2001

*
FLEXITALLIC
FLEXITALLIC

YARDSTICKS FOR GASKET PERFORMANCE

The No. 1 reason for specifying Flexitallic Spiral-Wound Gaskets is predictable performance. The compression characteristics of each Flexitallic Gasket are always related to the pressure/temperature ratings of the flange. They are made for each other.

But, beyond this, engineers know that Flexitallic Spiral-Wound Gaskets give important advantages such as:

- Wet or dry, there is no change in the compression characteristics of a Flexitallic Spiral-Wound Gasket.
- In Style CG Flexitallic Gaskets, the standard ring completely seals the flange with steel, and gives positive indication of effective bolt load.
- The Flexitallic Spiral-Wound construction gives the safest possible seal for flammable or toxic fluids.

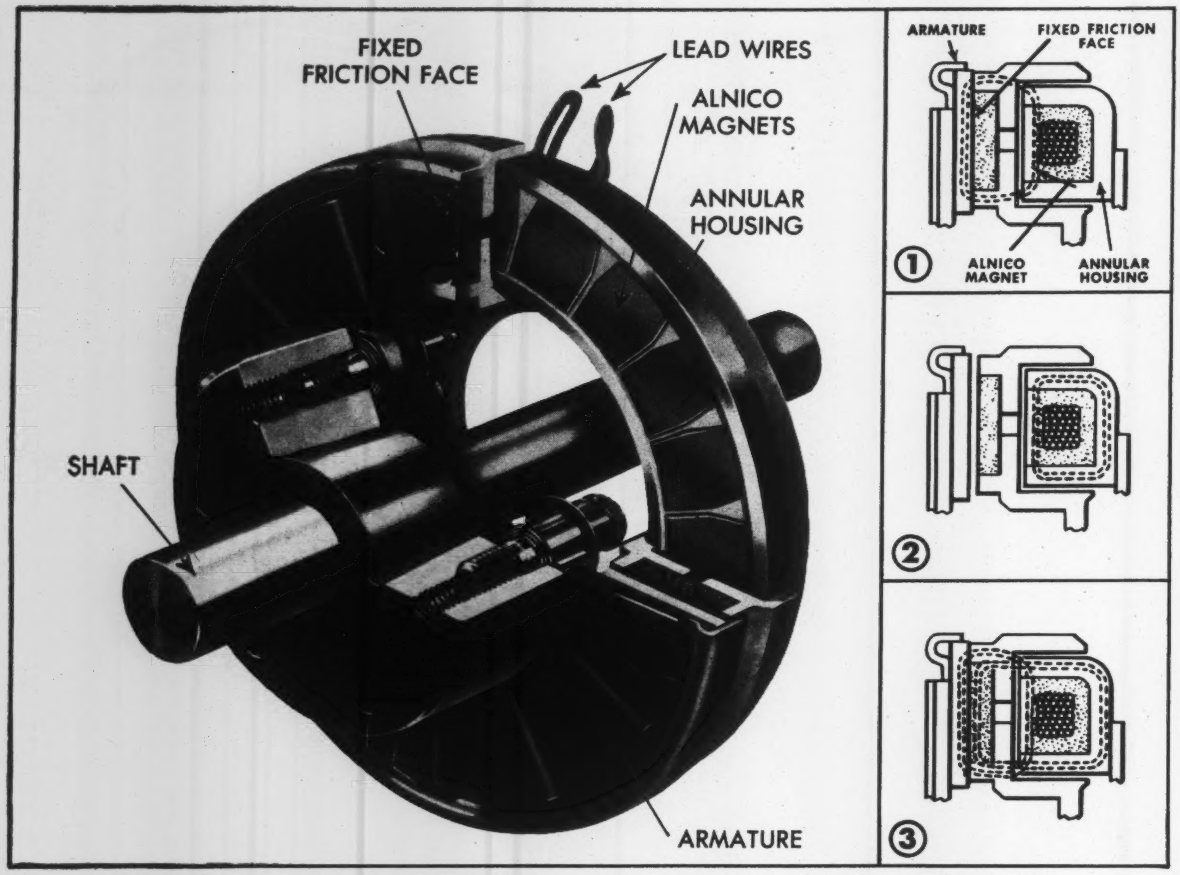
Flexitallic Blue, the blue-dyed Canadian asbestos filler, identifies the original Spiral-Wound Gasket construction.

FLEXITALLIC GASKET CO.
8th & Bailey Sts. Camden 2, N.J.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

* Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.



Nickel alloy permanent magnets give this Warner PER power brake its unusual fail-safe feature – no moving parts, no complex actuating devices. Magnets are produced by The Indiana Steel Products Company of Valparaiso, Indiana, for Warner Electric Brake & Clutch Company.

Tight magnetic grip of a nickel alloy simplifies new fail-safe power brake

This fail-safe power brake has but one moving part; the armature!

To get simplicity, the designer made use of the magnetic force of nickel-containing Alnico V alloy.

How it works

Magnets of Alnico V are built into stationary annular housing. When power fails, magnets pull revolving armature into tight contact with stationary annular housing's friction face, ① . . . rotation quickly stops. When power is turned on, current flows through field coil, diverting magnetic flux away from armature, ② . . . armature is released and retracted slightly for easy rotation. When current flow through field coil is reversed magnetic flux is reinforced, increasing braking torque, ③ . . . power braking can be controlled by varying current flow.

Special properties of nickel alloys fulfill many design needs

Designers meet a host of special metal needs with nickel alloys. For example:

. . . nickel-containing stainless steels give liquid oxygen containers in missiles their *low temperature toughness* . . . high nickel alloys armor jet engine thermocouple probes against *high temperature stress and corrosion* . . . carburized nickel alloys make rock drill bits exceedingly *hard* . . . other nickel alloy steels provide the extra *toughness* and *strength* to withstand the high shock stresses imposed on aircraft landing gear.

And so it goes! Wherever electrical, corrosive, abrasive or other conditions are severe, device after device makes use of the special properties of nickel-containing alloys!

If your products need metals of unusual capabilities, investigate nickel alloyed materials. An Inco consultation may help you select the best material for a specific use. (For more information about the brake illustrated, write Warner Brake and Clutch Company, Beloit, Wis.)

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO NICKEL

NICKEL MAKES ALLOYS PERFORM BETTER LONGER

MECHANICAL ENGINEERING

VOLUME 81 • NUMBER 9 • SEPTEMBER, 1959

Nuclear Peace Ship

Editor, J. J. JAKLITSCH, JR.

The launching of the world's first nuclear-powered passenger-cargo ship, the *NS* (for Nuclear Ship) *Savannah*, on July 21, by America's First Lady, Mrs. Dwight D. Eisenhower, demonstrated once again to the world the determination of the United States to develop and utilize the atom for peaceful purposes.

As the glistening white ship slid down one of New York Shipbuilding Corporation's huge glass-roofed ways in Camden, N. J., President Eisenhower's proposal for a nuclear-powered peace ship, which he made in a 1955 speech, became a reality. (See photo story in "The Roundup.")

It is fitting that the nuclear ship to usher in the atomic age of ocean travel be called *Savannah*. For on May 22, 1819, a 320-ton ship started an epoch-making voyage from Savannah, Ga., to Liverpool, England. She also was named *Savannah* and, as the first vessel to use steam on a transatlantic crossing, she ushered in the steam age on the ocean.

Responsibility for the development of this new nuclear-powered ship lies with the Maritime Administration and the U. S. Atomic Energy Commission. The vessel was designed by George G. Sharp, Inc.; The Babcock & Wilcox Company holds the prime contract for the propulsion machinery with DeLaval Steam Turbine Company as subcontractor for the turbines, reduction gears, and other heavy machinery.

While it is acknowledged that the *Savannah* will not attain economically competitive operation, she also is not intended as a prototype. Rather, it is planned to utilize this "first generation" nuclear merchant vessel to develop practical construction and operation technology and to employ this information in evaluating and designing "second and third generation" nuclear-powered ships which can attain competitive performance in free enterprise.

The *Savannah* will be a test ship. Special features, such as provision for extensive remote operation of components and the possibility of rapid maneuvering rates, which are not essential for proper performance of this type of ship, have been incorporated for evaluation in future designs.

Most important, however, the *Savannah* has these five noteworthy missions: (1) To demonstrate to the world the employment of nuclear power in an instrument of peace for the benefit of mankind; (2) to bring the power of the atom into the market places of the world in peaceful trade and commerce; (3) to demonstrate that nuclear-powered ships are entirely dependable and safe; (4) to stimulate early solutions to such problems as international liability and indemnification and win for nuclear ships acceptance in the world's ports; (5) to give the Maritime Administration and the AEC the opportunity for prudently assessing the possible contributions of atomic power to the progress of the American Merchant Marine.

The *Savannah's* rather elaborate provisions for shielding, reactor containment, ship structural integrity, safe storage of all wastes, and the continuous monitoring of every potentially hazardous condition are results of several years of study. These designs have been reviewed and accepted by the U. S. Coast Guard, the American Bureau of Shipping, and U. S. Public Health Service, and will meet the recommendations of the AEC Advisory Committee on Reactor Safeguards. In every case, design and construction practice has followed the recommendations of ASME and other technical societies.

When completed, the *NS Savannah* project will stand as a symbol of engineering achievement and at the same time underscore the intent of the United States to employ the atom for peaceful, productive purposes.—*J. J. Jaklitsch, Jr.*

MANAGEMENT LOOKS

Maintenance may be grouped into three rather broad and, perhaps, overlapping categories:

1 Emergency or breakdown maintenance
2 Routine or preventative maintenance
3 Scheduled or productive maintenance

Business, in general, is using either the emergency or preventative-maintenance plans or a combination of the two. An examination of certain phases of industry and business reveals rather clearly changes in maintenance concepts—some for the better, others for the worse. The railroads formerly observed either a preventative or productive-maintenance approach. In some cases they now observe a breakdown-maintenance policy because of their continuing financial straits which are largely due to unfair taxation. Moving in the other direction toward productive maintenance are some of the process industries. Still another pattern is found in the electric utilities which are faced with the dilemma of being unable, in many cases, to abide by the equipment manufacturer's recommendations for more frequent maintenance inspections than may be possible. This is because of the short periods of time available to attend to the required maintenance in the face of present generation requirements with available installed capacity. This has been aggravated by the development, in most systems, of both a summer and winter peak, which leaves no room for scheduled down time. Where this is a problem, selectivity becomes a consideration. It is then necessary to resolve the economic importance of certain newer and more efficient equipment where it would be very costly to tolerate a forced outage for extended maintenance at a period of critical requirement, as compared to the loss of such a unit for a planned or preventative maintenance outage.

With the increasing attention being given by some process industries, such as oil refineries, to placing an entire process operation under the guidance of electronic data processing equipment, the responsibilities on plant engineering and maintenance take on added significance. Economically, it is virtually prohibitive to have such an operation come out of service on an unscheduled basis. In this changing complexion of the industrial profile of this nation, the skills and competency of the plant personnel must play an ever-increasing role. Maintenance cost is becoming a larger fraction of operating cost in many businesses. The trend toward mechanizing and automating more operations is partially responsible for this. Jobs involving only unskilled manual labor, particularly on production jobs, are growing fewer because they tend to be economically inefficient.

Factors Affecting Maintenance

Quite a number of factors have a distinct bearing on the maintenance requirements of a productive or manufacturing facility. Among these are the nature of the tools, their age, and the extent of their usage. The skill of the machine tool or facility operator and his attitude are important. In power plants and large process plants, management must be continually comparing its depreciation expense versus its maintenance expense. Generally, where maintenance costs exceed depreciation charges, then the suggestion is inescapable that if more money were spent on facilities, less would be required for maintenance. A generous policy on facilities and good plant engineering obtains a good return on maintenance savings alone. In maintenance and plant engineering, management can find possibilities that justify the real efforts of its leaders, for maintenance runs throughout an entire business. Management must not give maintenance and plant engineering the leavings of its leadership talent. It is not profitable to skimp on maintenance people and on maintenance facilities, as was more commonly done in the past. Maintenance must not be deprived of a generous share of management's attention.

When one considers the extent of the capital investment in facilities and tools, supplemented by the extensive expense for maintaining the production worker at his work stand, it is immediately evident that neither breakdown maintenance nor preventative maintenance will contribute sufficiently to the low costs that are so necessary to competitive business. Certainly, they do not contribute to an increase in our productive efficiency. Productive maintenance is the planned application of men, materials, and tools to protect capital investment, to increase production, and to lower product costs. In fact, as American industry is gradually being automated, the "think" needed to keep production flowing is being shifted from the production worker to the maintenance worker. Productive maintenance requires competent people, complete records, and adequate renewal parts.

Productive and Preventative Maintenance

In most instances there is probably a definite distinction between productive maintenance and preventative maintenance. Maintenance must go beyond any negative concept. It must be looked upon as being as important as production itself. The productive maintenance program is usually applied to vital components in particular; that is, those where failure would directly or indirectly interrupt, delay, or curtail production.

Productive maintenance requires complete records. It is not enough to know that a motor failed; it is necessary to know the details of the failure and whether this is the first failure or the tenth. Knowing the nature of the difficulty pertaining to a specific application enables

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Based on a Banquet Address delivered at the Maintenance and Plant Engineering Division Conference, Chicago, Ill., May 4–5, 1959, of The American Society of Mechanical Engineers.

More and more, management will assign leadership talent to the development of maintenance and plant engineering

AT MAINTENANCE

By Glenn B. Warren, President, The American Society of Mechanical Engineers

realistic evaluation of the equipment and whether or not changes are desirable to reduce failure. Such maintenance records are a means of evaluation or a means of permitting maintenance management to evaluate the competency of its maintenance force and the duty imposed on the facility. A facility where piecework is being conducted, with an improper piecework rate, can be overtaxed, thus contributing to increased maintenance. On the other hand, these records, when used properly, can measure the competency of the maintenance people themselves or signal inadequate design by the manufacturer. A forward-looking maintenance organization will seize upon the opportunity to report promptly to the equipment manufacturer the nature of repetitive difficulties and to solicit his counsel.

Outages Are Costly

To illustrate the high losses from outages, both scheduled and principally unscheduled, examples will be used from the power industry although these will apply in varying degree to any continuous-process industry. These will illustrate the importance of records and the way in which these may be used to advantage by user and manufacturer and management.

In modern practice, where many considerations dictate a unit type of plant construction—one boiler, one turbine, one set of auxiliaries, and so on—increasing attention is being paid to availability. This is figured as 100 minus the per cent of both forced and planned outages for the entire unit. The loss, due to these two types of basically different outages, is becoming clearer. Actually, in the case of the electric utilities, this is taking on the complexion of additional investment which is required in a given system to give the equivalent service reliability.

This depends upon the relative size of the generating unit and the load it serves. Two extreme and unrealistic examples will make this clear. Suppose that a single 100,000-kw turbine-generator served a 100,000-kw load in a miraculous power plant that could be expected to have no scheduled or unscheduled outage. Obviously, no spare capacity would be needed. But, if such a plant had as little as 1 per cent unavailability and service had to be maintained, at least one complete spare would be necessary and the cost would be 100 per cent of the first power plant's cost. At the other extreme, such a load could be served with 100 1000-kw plants. Here, if there was 1 per cent unavailability, theoretically, only slightly more than one extra plant would be needed, or 1 per cent of the cost of the first basic plant.

Actually, most situations are in between and, with interconnections and other facilities, the equivalent of about 10 plants usually serve the load. In this case, 1 per cent increased planned outage usually costs only about $1 to $2 per kw—but, a 1 per cent increase in forced or unplanned outage, on many systems, may cost as much as $30 per kw for the new unit added in order to maintain the same quality of service. As more units of the higher forced-outage class are added, the cost of the extra reserves can be spread over more new units; but, even in the end, a 1 per cent higher forced-outage rate can be evaluated as costing as much as $7 per kw. This puts an increase of 1 per cent in the availability of the forced-outage type as worth from two to three times as much as 1 per cent increased fuel efficiency. Yet the value of this has been recognized and much of the research and development work directed at improving the efficiency of power plants has been concerned with fuel. Proper maintenance and plant engineering can go a long way toward reducing both planned and forced-outage time. In this connection, in the electric-utility business there is some tendency to postpone needed turbine maintenance, which will effect long-range economies in favor of short-range profits. A careful balance must always be maintained between proper short-range and long-range objectives in the field of maintenance and plant engineering.

These same principles may be equally applicable to many process plants, particularly those which run on a continuous basis.

An Opportunity for ASME

Lord Kelvin said, "Unless we can express in numbers what we are talking about, we have very little idea of what we are doing." The final point is that the Maintenance and Plant Engineering Division of the ASME can make a unique and worth-while contribution of this sort.

With the increasing importance of automation in industry and continuity of operation in process industries and in the utilities, this part of an operation becomes of increasing importance but, as indicated by the utility's example, of differing degree depending upon the nature of the equipment, the service, and the type of outage. As Lord Kelvin said, we know little about this until we can put numbers on it. For years, the Edison Electric Institute has been keeping invaluable records of power-plant component outages and these have been of tremendous assistance to the manufacturers and equipment designers as well. Over the past three years, these records have been largely nonexistent because the Edison Electric Institute is studying a change in form to make them even more valuable, but we should speedily catch up on the missing records. Such comprehensive records are unavailable elsewhere in the world in the electric-power field. This is, in no small measure, one reason for the higher reliability of our power-plant equipment.

Obtaining and analyzing such data on many other types of equipment would be difficult compared to that in the electric-utility power industry; but, nevertheless, an important start might be made.

UTILITIES STUDY

Incremental Maintenance

By R. H. Holyoak, Assoc. Mem. ASME

Efficiency Engineer, Generating Stations Div., Commonwealth Edison Company, Chicago, Ill.

DURING the past decade the electric-utility industry has commenced loading electric-generating units on an incremental basis, with the load dispatcher programming the addition of the cheapest kilowatts on a load increase and the subtraction of the most expensive kilowatts on a load decrease. The knowledge of what it costs in fuel to produce a kilowatt of power at a given load on a given machine is the tool which permits the electric-utility industry to effect this greater efficiency in operation of its electric generating units. This gain, with others, has helped offset the trend toward higher operating costs and has permitted relative stability in the rate structure of the electric-utility industry. In recent years, gains made through greater operating efficiency have required more investment per unit gain in efficiency, and this trend is becoming more accentuated as time passes.

The development of economic loading has required the study of incremental maintenance costs. Like incremental fuel loading, incremental maintenance loading can realize savings to industry. These savings are not in the magnitude of incremental fuel savings but they can be substantial and will increase as more knowledge of incremental maintenance loading is developed.

Analysis of Maintenance Costs

On first examination, in an approach to incremental maintenance, maintenance costs break into two categories when examining a power plant. These are: a fixed cost independent of the type of loading the station is experiencing, and a variable cost that is dependent on the station loading. The fixed cost cannot be changed by change in loading and is incurred because of the passage of time and because of maintenance of items that are independent of unit loading, such as buildings. The variable cost is of primary interest because this is partially controllable and accountable by the way in which the station is loaded.

An approximate fixed and variable maintenance cost has been used by splitting the total maintenance cost per unit produced by some experience-dictated percentage, such as 50 per cent fixed and 50 per cent variable, and applying this to all power plants in a system regardless of age or loading characteristics. This system leaves a lot to be desired, and the Commonwealth Edison Company, in order to take advantage of any possible savings that the installation of the Automatic Dispatch System would allow, made a study of incremental maintenance costs. This study was handicapped by the lack of operational data. Figures were not available that would tell whether maintenance costs with a turbine running at 100 per cent rated load would be twice those that would be incurred if it ran at 90 per cent of rated load.

The Commonwealth Edison Company did have an extensive accounting system that would help in such a study. Federal Power Commission accounting numbers were broken down much further so that a more accurate picture could be drawn of the places where maintenance costs were occurring.

The Approach Used

The first theoretical approach was one step removed from the 50/50-split approach. This was to state that the 50/50-split occurred at a given capacity factor—in this case, experience dictated a 75 per cent capacity factor. The fixed proportion of the maintenance remained constant, but the variable part of the maintenance varied with capacity factor, Fig. 1.

This method has the obvious disadvantage of not taking into account whether a unit is operated at 100 per cent average load for 10 per cent of the time or 10 per cent average load for 100 per cent of the time, each giving a 10 per cent capacity factor. In order to dispose of this problem, a new approach had to be used taking a third element into account.

This three-part approach is broken down as follows: The fixed element that is unaffected by anything but the passage of time; the no-load, which is the maintenance cost of running a machine unloaded; and the maintenance cost effect of loading a machine.

The best explanation of the three parts is perhaps brought out by a description of how the maintenance cost on a plant was arrived at for each part.

The Commonwealth Edison Company has available an extensive history of costs for the 12 generating stations in its system, and in each station maintenance costs are available for most of the components of a power station over a period of years. With the unavailability of actual tests showing maintenance-cost effects of various loadings on each component part of a power station, it was necessary to depend on the wealth of human experience available throughout the Generating Stations Department.

A detailed questionnaire and interviews gathered the experience of the Company's superintendents, master mechanics, boiler-room engineers, and others. Each man filled out a questionnaire that listed some 50 component parts of a power station, recording the percentages that he would assign to the three maintenance-cost factors: Fixed, no-load, and load to each plant component. A criterion of a plant and its components

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Costs

Problem for the utilities: To correlate maintenance costs with incremental loading. If this can be done with exactness, improved operation becomes possible.

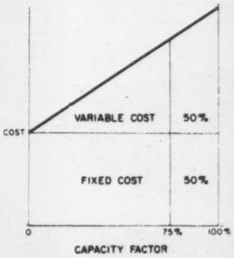

Fig. 1 Incremental maintenance cost with an estimated 50-50 cost split at a 75 per cent capacity factor

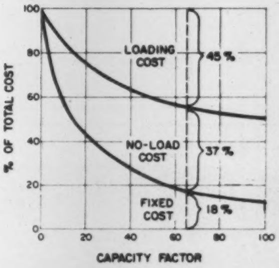

Fig. 2 Variations in incremental maintenance cost contributions of fixed cost, no-load cost, and loading cost with changes in capacity factor

operating at 80 per cent loading and 80 per cent of the time was set up to guide their thinking. Each estimate then had the Edison-system cost for several years for each component split according to the man's decision. The total of each of the three parts indicates a percentage for each part of a plant at 64 per cent capacity factor. These were averaged with the compilations of the man's contemporaries. Surprising correlation of opinion occurred on the loaded portion of the maintenance cost—this was 45 per cent at 64 per cent capacity factor. These were averaged with the compilations of the man's contemporaries. The no-load cost was rated at 37 per cent and the fixed cost at 18 per cent of the maintenance cost. Except for the fixed part, these costs were varied with capacity factor, with the resulting curve, Fig. 2.

Application

Application of these data and theory for practical use is the next step. The fixed cost is of no concern. This maintenance cost simply represents a certain sum of dollars which does not vary, no matter how many kilowatthours are produced. The third part or loading maintenance cost is the primary factor. With many machines operating, an incremental maintenance charge might change the economic relationship between the machines. While the figures are only of the order of $^1/_{10}$ of a mill per kilowatthour produced, millions of kilowatthours are involved. Knowing the maintenance cost of operating a unit over the same period of time, the cost per kilowatthour for maintenance can be derived. Correcting this cost to 64 per cent capacity factor, and taking 45 per cent of that, yield a loading maintenance cost for that unit at 64 per cent capacity factor. That loading cost is varied according to capacity factor to arrive at an incremental maintenance cost and apply it to the fuel and other charges on each unit in order to place it in its proper economic relationship with the other units on the system.

The second part or no-load maintenance cost usually does not enter the picture. This cost derives from the amount of time a machine is run. It has previously been determined, as accurately as possible, that a machine running 80 per cent of the time incurs 37 per cent of the maintenance cost if the loading is 80 per cent. From this a dollar cost per year for the no-load cost of operating a machine can be derived.

However, the cost of operating a machine per hour run per megawatt produced is of interest. This cost would be applied in calculations only if the load requires bringing up or shutting down a machine to meet load requirements. The charge would be in dollars per megawatt capability per hour on the line. This cost figure is calculated by dividing the cost in dollars per year for no-load operation by the total number of megawatthours, which is arrived at by multiplying the capability of the machine by the service hours for the period of time involved.

Operation with two fuels adds a complication but can readily be resolved. Operating maintenance costs while burning gas are regular unit-maintenance costs minus the coal handling, soot-blowing, and ash-handling maintenance costs. The latter would be added when burning coal. Incremental maintenance cost while burning coal will be higher than the over-all yearly costs where gas is burned. This results from the division of the coal maintenance costs by the kilowatthours produced while burning coal.

The same is true for the second part or no-load operation except that this is divided by the total load hours and coal-produced load hours.

In automatic-load-dispatching control, operation will be from a unit-heat-rate curve whose slope determines, along with other factors, when that unit will be loaded. With an incremental maintenance cost available, this can be added to the fuel-cost or heat-rate curve and the incremental maintenance costs entered in the calculations, resulting in lower system maintenance costs.

Future Refinements

With the advent of automatic data logging, it might be possible to determine in the future the maintenance-cost relationship of a machine operating at 90 per cent load and 100 per cent loading. When this time comes, it will be possible to plot more accurately when units should be loaded or unloaded and to reach into the power plant and calculate the maintenance-cost effect on plant components, such as running two or three circulating water pumps, or to determine when one forced-draft fan should be used instead of two. If incremental maintenance costs can be predicted with some exactness, then in theory a better job should be done in predicting normal maintenance requirements with all the resultant savings from better maintenance scheduling and better availability of machines.

Incremental-maintenance-cost accounting is a tool for more efficient operation and an aid in keeping unit electric costs down, in the face of rising general costs. In its present state of theory, and with the extensive use of judgment required in arriving at actual incremental maintenance figures, there is much to be desired. However, if the approach has permitted biasing the system in favor of the low-maintenance-cost machine, when fuel costs are equal, then a step forward has been taken.

By C. H. Harker
Maintenance Engineer, Caterpillar Tractor Company, Peoria, Ill.

Central Job Shop in
AREA MAINTENANCE

Your maintenance department's central shop may follow either a craft or functional division. Which is better for fluctuations in work load?

With the present trend toward a maintenance operation which is more closely geared to the production operation of a manufacturing plant, area maintenance has become the predominant type of maintenance organization. The development of central job shops has accompanied this trend. These provide the tools and special skills which cannot be duplicated in individual areas. Since almost any service which these shops provide can be purchased, the services to be provided are best determined by a comparison of the cost of purchasing such service against the cost of providing it within the company structure.

This comparison is affected by many variables: (*a*) Availability of the service in the plant locality, (*b*) type of manufacturing operation, (*c*) effect of union contracts, (*d*) availability of skills, (*e*) relationship to other company plants, (*f*) quality of work required, (*g*) time required to obtain service, or (*h*) production time lost through delay in repair.

As to the effect of the type of manufacturing operation, a heavy equipment manufacturer would have more need for a machine section in a central shop than a textile manufacturer. Where quality of work must be held to a high degree, it may be considered essential to retain the work within the company. When a multiple-plant organization exists, there is an opportunity to provide certain specialized skills in the central job shop.

With an analysis of these needs a central shop may be developed for the purpose of supplying a variety of fabrication or repair services ranging from automotive equipment repair to upholstery, sign painting, salvage, sheetmetal work, or blacksmithing as required.

Good management in such areas as organization, job classification, tooling, layout, work measurement, and work scheduling must be constantly exercised.

Organization

Organization of a job shop may follow either a craft division or a functional division, or a combination of both. Flexibility in meeting fluctuating work loads is a major requisite. There is more fluctuation in work load for fabrication than for repair. In general, fabrication work is best handled in a functional organization, and repair work is best handled in a craft organization.

As an example of the advantages of a combination-type organization, a typical craft organization will be used and then changed to a combination craft and functional organization. By combining the millwright, tinner, and welder groups into three functional groups, specialized groups can be provided for heavy fabrication, light fabrication, and repair, as illustrated in Fig. 1.

Tools and Layout

Careful studies of work burden must be made to provide an accurate selection of machine tools for central shops. In general, the tools must provide a wide range of adaptation to a variety of work.

The layout of the tools and shop areas is related to the organization. One of the advantages of the craft layout is that tools and machines can be grouped together for minimum travel between operations. In the functional-type organization, tools must be placed in the area in which they are most used with the necessary space allotted to allow for the use of the tools by other groups

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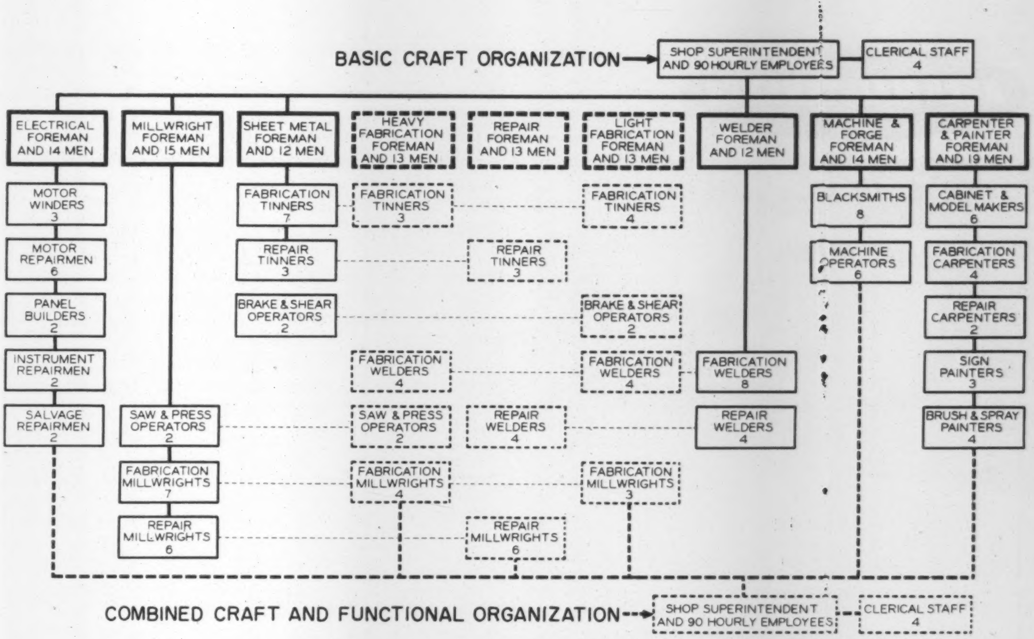
Condensed from "The Role of a Central Job Shop in Area Maintenance," ASME Paper No. 59—MPE-2.


BASIC CRAFT ORGANIZATION
SHOP SUPERINTENDENT AND 90 HOURLY EMPLOYEES
CLERICAL STAFF 4
ELECTRICAL FOREMAN AND 14 MEN
MILLWRIGHT FOREMAN AND 15 MEN
SHEET METAL FOREMAN AND 12 MEN
HEAVY FABRICATION FOREMAN AND 13 MEN
REPAIR FOREMAN AND 13 MEN
LIGHT FABRICATION FOREMAN AND 13 MEN
WELDER FOREMAN AND 12 MEN
MACHINE & FORGE FOREMAN AND 14 MEN
CARPENTER & PAINTER FOREMAN AND 19 MEN
MOTOR WINDERS 3
MOTOR REPAIRMEN 6
PANEL BUILDERS 2
INSTRUMENT REPAIRMEN 2
SALVAGE REPAIRMEN 2
SAW & PRESS OPERATORS 2
FABRICATION MILLWRIGHTS 7
REPAIR MILLWRIGHTS 6
FABRICATION TINNERS 7
REPAIR TINNERS 3
BRAKE & SHEAR OPERATORS 2
FABRICATION TINNERS 3
FABRICATION WELDERS 4
SAW & PRESS OPERATORS 2
FABRICATION MILLWRIGHTS 4
REPAIR TINNERS 3
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FABRICATION TINNERS 4
BRAKE & SHEAR OPERATORS 2
FABRICATION WELDERS 4
FABRICATION MILLWRIGHTS 3
FABRICATION WELDERS 8
REPAIR WELDERS 4
BLACKSMITHS 8
MACHINE OPERATORS 6
CABINET & MODEL MAKERS 6
FABRICATION CARPENTERS 4
REPAIR CARPENTERS 2
SIGN PAINTERS 3
BRUSH & SPRAY PAINTERS 4
COMBINED CRAFT AND FUNCTIONAL ORGANIZATION
SHOP SUPERINTENDENT AND 90 HOURLY EMPLOYEES
CLERICAL STAFF 4

Fig. 1 Two types of job-shop organization are shown on this diagram. Both are composed of a clerical staff of 4, a shop superintendent, and 90 hourly employees. The portions of the organization that have been changed are indicated by the dotted **horizontal** lines. Dotted **vertical** lines indicate which columns are included in the new combined craft and functional organization which is a more efficient use of labor.

in the shop. A study of the type of work to be performed will provide the step-by-step flow that is common to most jobs. The layout should facilitate the establishment of this most common flow pattern with the least movement of men and materials. At the same time, a central job shop must be laid out to allow flexibility for unusual type of work that will occasionally interrupt the natural flow. For instance, in a motor-repair shop a good layout will provide for the orderly progression of the component parts from disassembly, to cleaning, to rewinding, to reassembly, to final test of the most commonly used motors. However, the layout must also take into account the occasional need for repair of a large-horsepower motor with which the normal flow pattern is not possible.

Work Measurement

Through work measurement the central shop is able to plan and schedule, evaluate various performance methods, and seek to receive a full 8 hr of work for 8 hr of pay. The variety of nonrepetitive jobs in a central job shop makes work measurement difficult. On the repetitive type of work found in a production shop, time studies by stop watch or predetermined standard motion studies provide an accurate measurement which can be assigned to the particular job as it is repeated. For nonrepetitive jobs, one method that can be used is an estimated standard time based on analysis of work orders. This requires skilled processors, detailed blueprints, and well-defined orders, and the method is costly and results in many disputes over time allotment.

Another method, and one of the most useful work-measurement tools in the central shop, is random sampling, which provides a means of measuring performance regardless of nonrepetitive work. Advantages are: (*a*) Low cost of application; (*b*) group application creates less resistance among employees; (*c*) the foreman's responsibility to correct wasteful methods and eliminate lost time is retained.

The fact is often overlooked that foremen who are faced with a low performance rating will locate the wasteful methods which are responsible. This also provides a challenge and an opportunity for foremen to develop and attain real leadership and management ability.

Job Classifications

Narrow and restrictive job classifications are one of the greatest handicaps to profitable job-shop operation today. These classifications are the result of the historical practice of limiting the development of individual skills by narrowly defined trade classifications. They are an outgrowth of the trade-guild development of the 18th century and, although they had their place in both European and American industrial development, they are no longer needed.

The development of industrial training programs has enabled individuals to perform work in a broader range of skills, but a pride in craft names remains. Unfortunately, the individual millwright who takes pride in that designation may or may not have the complete range of skills from carpenter to machinist which is currently implied.

To have the most productive operation, it is necessary to have maximum flexibility in the classification. Distinction must be made between skills that require training and experience and those which are acquired through normal everyday living. In other words, basic skills such as hammering, assembly and removal of bolts and nuts, sawing, filing, and drilling are acquired by all crafts. Employees of any craft should assist other crafts in these activities.

Welding provides a particular example of lost pro-

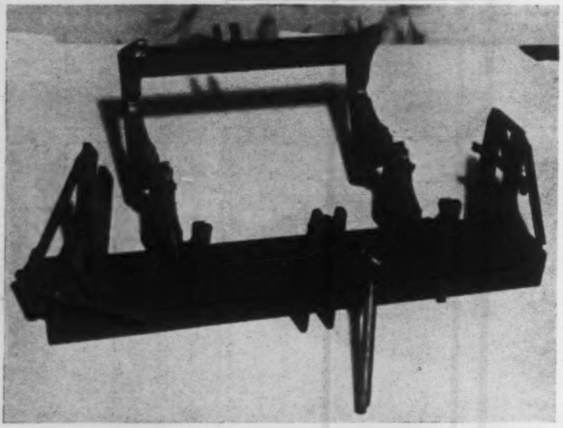

Fig. 2 A low-cost welding fixture is an aid in reducing the amount of waiting time caused by the welding operation

duction in the central job shop. Any type of fabrication whether pipe, structural-steel, or sheet-metal will require welding. If the welder is established as a separate classification, there will be a great amount of waiting time between the welding operation and the other operations performed by the millwright, pipefitter, or tinner classifications. As much as 50 per cent of productive time has been lost in many cases on fabrication operations requiring welding. This can be partially corrected through the use of welding fixtures, Fig. 2, and through the use of tacking subassemblies prior to final welding. Probably the most effective way to eliminate this problem is to combine the welding skills with the other craft skills. This is often difficult to develop since training in welding skills is required.

Certain types of work do occur which can best be performed by specialist classifications. These must be evaluated carefully to insure long-term need before establishment of special classifications. Such classifications are: (*a*) Instrument repairman, (*b*) welding-equipment repairman, (*c*) motor winder, (*d*) salvage repairman, (*e*) lifting-device repairman.

In many cases, this specialist work can be assigned to the older or physically handicapped employees. A high development of skill within their limitations will often compensate for the lack of flexibility in specialist classifications.

Scheduling

With many different sources of work coming into the central shop and with various demands for completion dates, orderly progress of the work through the shop is essential. There are five basic requirements for scheduling: (*a*) A method of measuring work burden; (*b*) a means of establishing the priority of orders; (*c*) maintenance of a balance of work between the various crafts; (*d*) establishment of completion dates which allow sufficient time for procuring materials and establishing best work methods; (*e*) maintenance of a stable work force.

The measurement of work burden can be accomplished by: (*a*) Estimating burden hours per craft for each order, (*b*) calculating average burden hours per order from completed orders and past performance, (*c*) using random-sampling methods for determining average burden hours per craft for the various types of orders processed.

Estimating burden hours will give the most accurate result. The other two methods are subject to error with the changes in the mixture of work being processed. However, estimating burden from standard time values is costly and requires the same skilled processors, detailed blueprints, and well-defined orders as in the case of using processed time for establishing a measure of performance. Here again, work sampling can provide a good method at small cost.

Order priority must be established in accord with the general plans of the plant management. The Planning Department is usually responsible for creating production and facility changes. If no such department exists, and the responsibility is not better assumed elsewhere, it is important for the shop management to undertake it rather than operate without any established priority. Factors which affect priority are: (*a*) Model changes, (*b*) expansion of production facilities, (*c*) improvement of production facilities, (*d*) special-product requirements.

If the work load scheduled to the various crafts is not balanced, productive time will be lost from the increase in waiting time and interference between the crafts. Employees in a shop are quick to sense these situations. They cause excessive visiting, discussion, and other conditions which are not conducive to efficient work or good quality.

Other factors which must be evaluated in establishing a schedule are: (*a*) Average order-processing time, (*b*) average design time, (*c*) average material-procurement time. A simple example will show how these factors can be used for establishing a schedule

1 Establish total *average* process time for a given type of order:

Order-processing time	14 days
Design time	25 days
Material-procurement time	30 days
Shop process time	2 days
Total average processing time	71 days

2 Calculate total shop process time:

Number of orders on schedule	36
Average shop process time	2 days
Total days scheduled	72 days

This condition represents a good balance providing time for all factors in the processing of an order. When shop process time exceeds total average process time, completion date on orders must be delayed, work force must be increased, or overtime hours provided. When shop process time is less than average process time, the shop will be waiting for material or designs.

Conclusion

The function of a central shop in area-maintenance-type operations is to support the maintenance areas by performing work which requires special skills, facilities, or tools which cannot be justified economically for duplication in the maintenance area. To do this most profitably requires: (*a*) Combination craft and functional organization, (*b*) universal and adaptable tooling, (*c*) a layout providing for smooth work flow and good housekeeping, (*d*) a means of determining work performance, (*e*) flexible classifications, (*f*) well-defined work schedules.

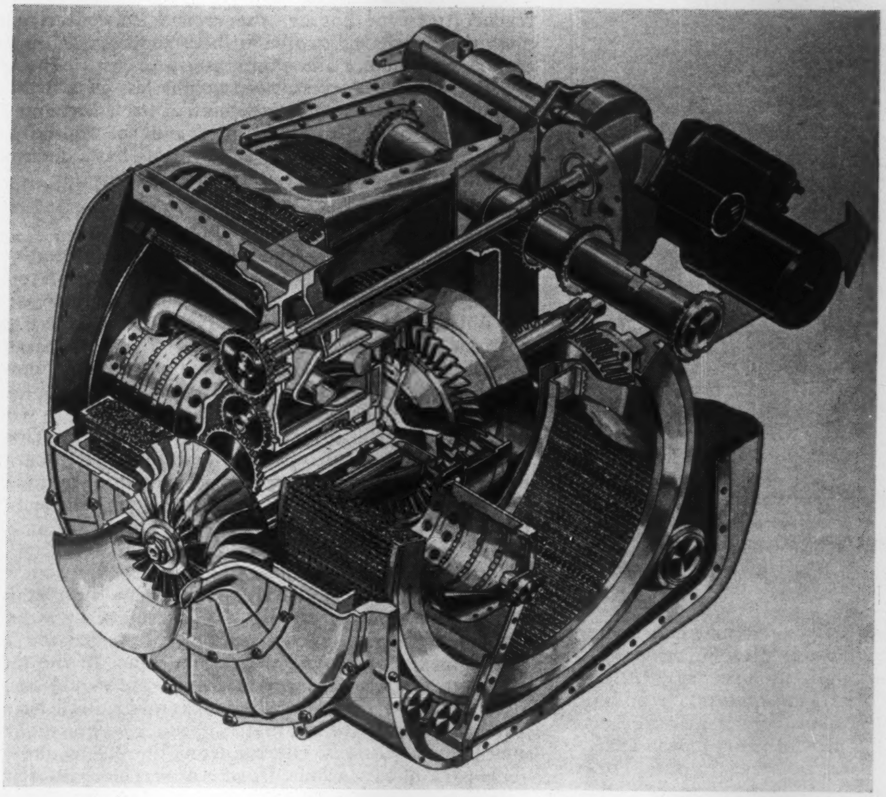

Fig. 1 General Motors GT-305 regenerative gas-turbine engine

Engineers are bringing the gas turbine into competitive range with the automobile piston engine. Here is GM's Whirlfire, using a rotary regenerator. Economy calls for regeneration. Now, the search is for new and better heat-transfer surfaces.

Regenerators for the "WHIRLFIRE"

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For a gas-turbine engine to be economical in automotive operation, it is essential that it be of the regenerative-cycle type. Since the addition of the regenerator complicates the mechanical design of such an engine, it is necessary to view all the various parameters affected by the regenerator in relation to their effects on the operation of the engine. A regenerator by itself cannot drive the rear wheels of the vehicle but can only improve the efficiency of the engine of which it is a part.

Rotary and Stationary Regenerators

Several comparisons were made between rotary (periodic-flow) and stationary (steady-flow) regenerators. The rotary regenerator was chosen after studies demonstrated 85 per cent effectiveness for the rotary regenerator compared with 60 per cent for the stationary regenerator. Comparisons were made on the basis of equivalent size, weight, and horsepower, and utilizing the best surface for each type.

The GT-305 engine is of the free-turbine type, Fig. 1. The centrifugal compressor operates at a design-point pressure ratio of 3.5:1. The axial-flow turbines are designed for a maximum turbine-inlet temperature of 1650 F. The regenerator surface has been broken into two drum-type elements. Their axis is at right angles to the axis of rotation of the compressors and turbines and they are spaced apart so that the shafting between the compressor and the turbines and the output shaft of the power turbine may pass between them. Thus all of the high-temperature components of the engine are tucked inside the regenerators; that is, the combustion chambers, the gasifier turbine, and the power turbine.

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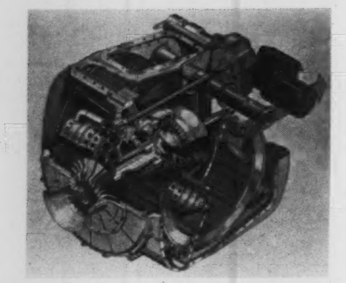


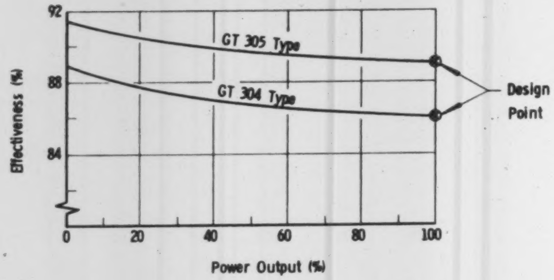


Fig. 2. Regenerator effectiveness for the GT-305 engine

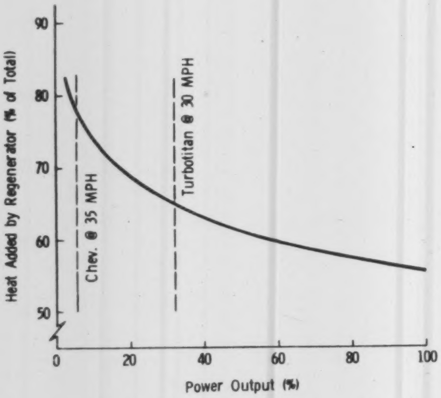


Fig. 3 Heat added by the regenerator

Compressed air leaving the compressor flows radially inward through the regenerator drum. Heat which has been stored in the porous media of the regenerator is transferred to the air raising it to about 1100 F. The temperature of the gas is raised further in the burners and then is expanded in the gasifier and power turbine. At this point it passes radially outward through the regenerator drum, storing heat in the metal. The regenerator matrix rotates at about 30 rpm and the storing and releasing of heat from the metal raises and lowers the temperature of any particular incremental part of the matrix 125 deg F. The radial temperature gradient in the matrix between the inside and the outside is approximately 800 deg F.

This mechanical arrangement of the GT-305 Whirlfire gas turbine epitomizes the need for integrating the regenerator into the over-all engine. Thus, just as the engine-cycle pressure ratio must be selected to best fit the regenerative-type engine, the regenerator effectiveness must also be selected to give the best compromise between engine performance and engine size and cost. The GT-305, including all accessories, weighs less than 3 lb per output shp. The regenerator matrix itself accounts for 25 per cent of the total weight; and the frontal area of the regenerator—the OD and width—has a determining influence on the over-all package dimensions.

Drum and Disk-Type Regenerators

Both drum and disk-type regenerators have been built and tested at General Motors Research Laboratories. The drum type was selected for two principal reasons: (*a*) With a seal of the clearance type, the leakage is proportional to the seal perimeter times the seal clearance; by correctly proportioning the matrix OD and matrix width for a given frontal area, it is possible to obtain a seal perimeter which is only 50 per cent as great as would be required for a disk-type regenerator of the same frontal area. (*b*) The drum-type regenerator can be integrated into the mechanical arrangement of the engine more satisfactorily with fewer bends in the air-flow path and less external plumbing.

The regenerator matrices are $21^3/_8$ in. at their OD, $8^1/_8$ in. wide, and 2 in. thick in the radial-flow direction. One of the early matrices positioned in the regenerator test rig is shown in Fig. 4. The matrix was originally composed of layers of woven-wire screen and shim stock stacked up around the circumference of the regenerator in the same manner in which one would stack a deck of cards. The wire screen was folded in such a way that the porosity of the matrix (void volume/total volume) was essentially uniform from the ID to the OD. This pack of shims and wire screens was mechanically retained between two geared rims which were used both to drive the entire assembly and to position it in the engine structure. Currently an improved, light, and somewhat flimsy heat-transfer surface is being used with the same mechanical construction. This has a higher effectiveness—88.5 per cent—for the same drop.

The regenerator matrix is supported and driven by two shafts located on the exhaust-gas-outlet side of the regenerator drum. These are positioned 30 deg above and 37 deg below the horizontal center line of the matrix. In the engine these are cross shafts which extend from one side to the other. They are supported in the center engine structure on a pair of taper roller bearings. The shafts are "cantilevered" toward the outside of the engine so that there are no outboard bearings.

Heat-Exchanger Performance

The three items of regenerator performance which most affect the over-all performance of the engine are effectiveness, pressure drop, and seal leakage. Effectiveness is defined as the amount of heat which is actually recovered over the maximum amount of heat which it is possible to recover. This affects the engine by reducing the amount of fuel which must be burned to raise the temperature of the compressed air up to turbine-inlet temperature. The pressure drop across the regenerator affects the engine performance by reducing the pressure ratio across the power turbine, hence reducing the output shaft horsepower. These two parameters are related to one another. In order to increase the effectiveness of a regenerator of a given frontal area and a given heat-transfer surface, it is also necessary to increase the pressure drop. Seal leakage is somewhat independent of the former two (except in so far as the size of drum affects the perimeter of the seal), but it affects the engine performance by by-passing gas which has been compressed in the compressor around the two turbines to the exhaust, hence decreasing the output shaft horsepower.

Effectiveness

The actual measured effectiveness of the GT-305 regenerators is shown in Fig. 2. Thus far, two general types of matrices have been operated in the GT-305 engine. The first was similar in construction to that used in the matrices of the GT-304 engine. The design-point effectiveness was actually attained in tests. For the GT-304 type it was 86.2 per cent and 88.5 for the GT-305 type.

As the power output goes down, hence as the weight flow goes down, the effectiveness rises. The weight flow decreases more rapidly than the heat-transfer coefficient, therefore increasing the number of transfer units, NTU. NTU is defined by the ratio of the temperature rise in the fluid with the minimum capacity rate divided by the log mean-average temperature difference between the two fluids. This is also equivalent to the over-all heat-transfer coefficient times the total surface area divided by the weight flow times the specific heat of the fluid on the minimum side. However, the increase in effectiveness at lower air flows is not as great as would be predicted theoretically. There is a loss of effectiveness due to conduction of heat through the matrix pack from the hot inside edge to the cold outside edge. This loss of effectiveness due to conduction is more serious at lower air flows than at high by a factor of $2^1/_2$. While the loss of effectiveness due to the conduction of GT-305 regenerators is small, it must be reckoned with cautiously or a rather disappointing regenerator performance might result.

The per cent of heat added by the regenerator versus the power output of the GT-305 Whirlfire engine is plotted in Fig. 3. At 100 per cent power, the regenerator is supplying approximately 56 per cent of the heat to the cycle, and the burner 44 per cent. At idle conditions, the regenerator is supplying approximately 85 per cent of the heat to the cycle. If the effectiveness could be increased just 1 per cent at idle, the fuel consumption would be reduced approximately 7 per cent. An increase of this amount would improve the miles per gallon of a Chevrolet passenger car equipped with the Whirlfire engine between 4 and 5 per cent.

Once effectiveness of 85 to 90 per cent have been obtained, it becomes increasingly difficult to raise the effectiveness further. Most of the designs of the regenerators for the GT-304 and GT-305 engines have been designed for a capacity-rate ratio of approximately 5. This is a compromise between the desire for the maximum effectiveness possible and the good common-sense approach to minimum carryover leakage and maximum durability of the matrix and associated components.

Pressure Loss

In order to achieve the benefits which have been discussed, certain penalties must be levied: (*a*) The regenerator tends to be a bulky object, and (*b*) it requires some pressure drop if any heat is to be transferred. Fortunately, there is an optimum pressure drop for a given regenerator size and engine configuration which will give the best fuel economy. The optimum pressure drop for the regenerator with the woven-wire type of matrix is about $5^1/_2$ per cent, or slightly lower. Gains in brake specific fuel consumption (BSFC) are less as the size of the regenerator increases, and, all factors considered, the selected design point for the GT-305 regenerator was for 2.3 sq ft of frontal area per 100 hp.

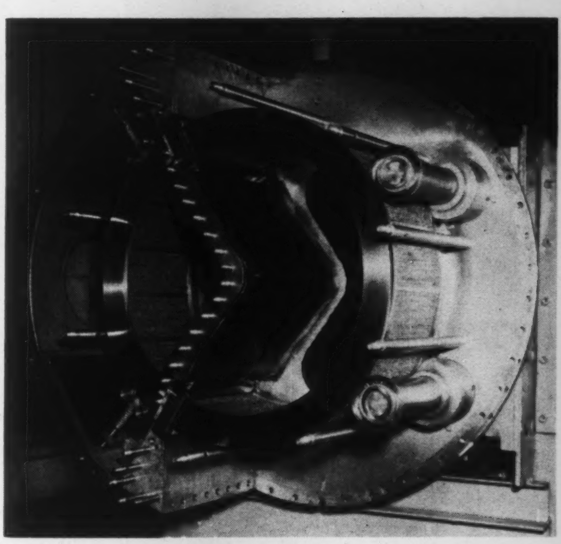
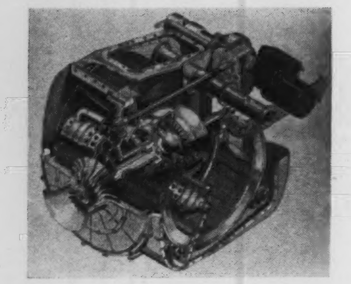


Fig. 4 GT-305 regenerator matrix mounted in the performance test stand

The pressure-drop characteristics over the load range of the GT-305 regenerator are shown in Fig. 5, in which the per cent pressure drop on the air side, gas side, and total are shown plotted versus the power output in per cent. The per cent pressure drop at 100 per cent power on the air side is 1.5 per cent, the gas side is 3.7 per cent, and the total is 5.2 per cent. While the percentage pressure drop is quite different on the two sides, the actual pressure drops are nearly equal; that is, 0.76 psi on the air side and 0.59 psi on the gas side. The pressure drop on the air side is relatively constant across the load range because the pressure of the gas on this side varies almost directly with air flow. However, on the gas side the pressures and temperatures are almost constant with load and therefore the per cent pressure drop tends to increase as air flow is increased for higher power outputs. The sum total of these two pressure drops fortunately falls off more rapidly at lighter loads where the parasitic losses extract the most severe penalty.

In order to attain maximum effectiveness, there is an optimum split between the pressure drop on the gas side relative to the pressure drop on the air side. This is attained by splitting the frontal area presented to the gas side (hot side) relative to the frontal area for the air side (cold side). Fig. 6 is a plot of the optimum frontal area split for the GT-305 regenerators. Plotted on the ordinate is the ratio NTU_0 divided by $\Delta P/P_{total}$ versus the frontal-area ratio (hot side/cold side). The ratio of the number of transfer units divided by the percentage pressure drop is a "goodness factor" for a particular regenerator surface. Since effectiveness is a function of NTU_0, this illustrates the utilization of pressure drop in obtaining effectiveness. The optimum frontal-area ratio for the



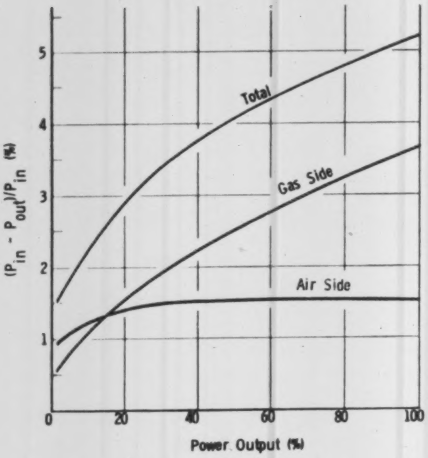


Fig. 5 Pressure-drop characteristics of the GT-305

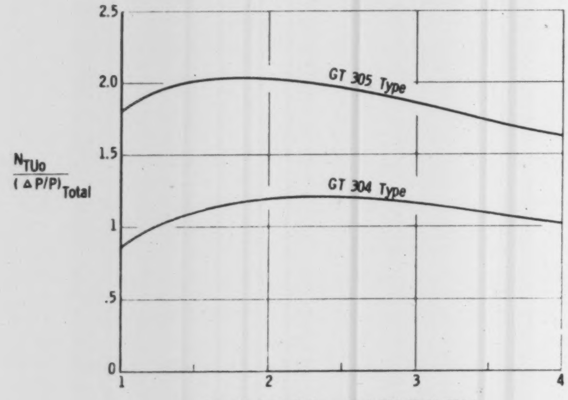


Fig. 6 Optimum frontal-area split of the GT-305 engine

GT-304-type heat-transfer surface is around 2.5:1, whereas the optimum frontal-area ratio for the GT-305-type surface is around 1.8:1. Fortunately, the choice of frontal-area split is not critical, and on the 305 engine a frontal-area ratio of 2 has been chosen which prescribes a percentage pressure-drop ratio of 2.46:1. This curve also serves to illustrate the better utilization of pressure drop by the GT-305-type surface since it has almost 60 per cent higher NTU_0 for a given $\Delta P/P_{\mathrm{total}}$.

Seal Leakage

The primary disadvantage of the rotary-type regenerator is a loss of high-pressure working fluid through the regenerator seals which consequently does not pass through the turbines. This loss of working fluid results in a decrease in engine efficiency. The measured leakage in per cent of total engine air flow for the GT-305 regenerator seals varies from approximately $2^1/_2$ per cent at idle to just under 4 per cent at 100 per cent power.

Still another type of leakage which must be considered with the rotary regenerator is "by-pass leakage"—the air which flows around the outside of the regenerator matrix without going through the matrix core. Since the pressure drop across the matrix is small, this leakage is usually easy to control and normally can be kept to 1 per cent or less of the total air flow. A 1 per cent by-pass leakage on both the air and gas sides results in a drop of installed effectiveness of 0.8 per cent.

Operational Experience

Most of the operational experience on this general type of matrix construction has been compiled with the GT-304 engine. One of the matrices for this engine ran over 1100 hr before a serious failure occurred. This particular failure was not attributable to a shortcoming in the matrix construction but rather to a failure of another part in the engine. Accelerated comparative tests indicate that the 305 matrix is several times as durable. Thus it is believed that a mechanical technique for gathering together this light and somewhat flimsy heat-transfer surface has evolved which gives a respectable expected service life.

One of the problems which was anticipated during the early consideration of this type of regenerator that did not materialize was "fouling." This is the clogging of the minute passages with dirt or products of combustion. The reversal of flow, as the matrix rotates from the hot side to the cold side, causes what was a stagnant area during flow in one direction to become a turbulent area during flow in the opposite direction. Furthermore, during engine accelerations and changes of engine operating conditions, the temperature patterns throughout the matrix shift and any carbon which may have collected is believed to be burned off in this fashion during the engine acceleration.

Further Development

A continuing research project is being carried out in the search for new and improved heat-transfer surfaces for the regenerator. A test technique has been developed which requires only a small test specimen to obtain complete flow-friction and heat-transfer data of a particular surface.

A regenerator test rig has also been built in which engine operating conditions can be simulated. The data from this rig are reduced with the aid of a data-reduction program on an IBM 704 digital computer.

Acknowledgment

The author wishes to thank all the members of the Engineering Development Department who have participated in the teamwork which developed the regenerator for the GT-305 engine. Messrs. R. J. Moffat, F. A. Creswick, and J. R. Mondt were especially helpful in the preparation of this report.

A REVIEW OF Metal-Processing Literature[1]

METAL CUTTING[2]

By J. M. Galimberti,[3] R. S. Hahn,[4] H. J. Siekmann,[5] and E. G. Thomsen[6]

The mechanism of continuous-chip formation is still a problem of vital interest as indicated by the number of papers on that subject.

Chip Formation

The Conference on Technology of Engineering Manufacture, London, England, April, 1958 [1][7] provided a good literature review. Pugh [2] and Chisholm [3] presented summaries of present knowledge on the mechanics of continuous-chip formation. Their estimate is as follows: Solutions due to Ernst and Merchant, Merchant, Lee and Shaffer, and Hill dealing with the metal-cutting-angle relationships are not in complete agreement with all the experimental observations. Hence, ideal plastic-solid (slip-line) methods or minimum-energy principles applied to the problem of orthogonal metal cutting do not yield unique solutions. Apparently Pugh and Chisholm also believe that the shearing stress on the shear plane is not a function of normal stress. Kececioglu [4,5] in his cutting tests with mild steel appears to confirm this belief, but suggests that the shearing stress on the shear plane is a function of temperature and hence of strain rate. On close examination, however, Kececioglu's data reveal that there is no significant trend of shear stress with strain rate and that the assumed trend is merely a scatter of points due to experimental errors. More recent investigations of Trigger and Chao [6] and Kobayashi and Thomsen [7] seem to confirm earlier claims that the shearing stress in metal cutting is unaffected by strain rate, feed, and rake angle. This observation may have far-reaching effects on clearing up the mystery of what is happening in the metal-cutting zone. When more is known about the mechanism of sliding friction, it may be possible to arrive at a more complete understanding of the mechanism of metal cutting.

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[1] Based on three papers contributed by the Production Engineering Division and presented at the Production Engineering Conference, Detroit, Mich., May 12–14, 1959, of The American Society of Mechanical Engineers.

[2] Condensed from Paper No. 59-Prod-6.

[3] Project engineer, Kennametal, Inc., Latrobe, Pa. Mem. ASME.

[4] The Heald Machine Company, Worcester, Mass. Mem. ASME.

[5] Manager, Applied Mechanics Engineering, Metallurgical Products Department, General Electric Company, Detroit, Mich. Mem. ASME.

[6] Professor of metal processing, University of California, Berkeley, Calif. Mem. ASME.

[7] Numbers in brackets designate References at end of paper.

Plasticity in Metal Cutting

Bastien and Weisz [8] examined the plasticity condition in metal cutting and found some correlation with the static properties of the workpiece similar to that reported earlier by Lapsley, et al. [9], and more recently by Kobayashi and Thomsen [7]. Kronenberg's suggestion [10] that dynamic effects in the metal-cutting zone are important must be questioned on the basis that calculations would show that surface forces due to stresses are more important than inertia forces. Takeyama and Usui [11] initiated a series of experiments with single-point cutting tools having controlled chip-tool contact areas which suggest a promising approach to metal-cutting research. More recently, Trigger and Chao [6] also reported some studies with controlled chip-tool contact areas and found that a relatively small chip-contact area improves the machining process. Heginbotham [12] discussed the built-up edge solution of Lee and Shaffer and apparently obtained qualitative agreement regarding increasing size of built-up edge with decreasing rake angle. Inasmuch as the ideal plastic-solid solution is not a unique solution, and since Shaw, et al. [13], had shown earlier that some test conditions would actually demand a negative or imaginary built-up edge of the Lee and Shaffer type, it must be assumed that present agreement is fortuitous and insignificant. Another paper of some interest is that by Eugene [14] where chip formation deduced from high-speed photographs is discussed. While this paper gives no new advance in analysis, it offers some interesting ideas on possible ripple formation on the backside of the chip, provided the quick-stop device employed did not alter the cutting action.

Drill Design

Ernst and Haggerty [15] claim that the introduction of the new spiral-point drill gives better cutting action than the chisel point and produces better chip formation accompanied by reduced end thrust. Adam [16] points out that the usually accepted rake angle is the angle in a plane perpendicular to the cutting edge, but this is not necessarily the true rake angle if the chip flows in a different direction. He then derives analytical expressions for determining the true rake angle for both straight and curved cutting edges and for both definitions of true rake angles. However, he does not venture to say which of the two is the correct true rake angle.

Cutting Forces in Machining Operations

Victor [17], in studies of cutting forces in turning, shaping, and drilling, finds that the cutting-force formula $F = wkt^n$, where F = cutting force, w = width, k = constant, t = undeformed thickness of layer removed, and n = exponent of t, holds approximately for all three operations. Kumake and Masuko [18] measured cutting forces in turning in the $+ 10$ C to $- 60$ C range. They found no relationship between hardness and cutting forces, but the impact strength and cutting forces gave similar functions of temperature when mild steel, brass, and duraluminum were machined. It is unfortunate that shear-plane angles and shear stresses were not quoted, since a comparison of shear stresses with impact strength would probably have greater significance.

Okushima [19] describes tests using a stationary tool dynamometer and block-workpiece sliding on an inclined plane for cutting tests up to 250 m per min when cutting mild steel and brass. This appears to be a novel test apparatus whose main purpose is isolation of the test equipment to eliminate vibrations. Vogt [20] describes another special apparatus for cutting tests, in which a tool is mounted on a so-called Leyensetter pendulum. The tool is stopped in the cut by adjustment of weights on the pendulum for the various speeds, thus yielding constant energy absorption. An approximate chip ratio was measured from the tool trace on the workpiece and the compressed chip still attached to the workpiece. These chip ratios as functions of speed showed discontinuities in the curves which are explained by a microdiffusion process of migrating carbon atoms during plastic flow. The method of testing seems to be novel but the explanation of the results would appear to be unrealistic, since changes in friction and in shear angle can account for the observations.

Tool Life and Wear

A number of papers dealing with tool life and wear are of general interest, but because of the complexities of the mechanisms involved are of descriptive rather than analytical types. A possible exception is Vieregge [21]. Curves of tool wear are given as functions of cutting speeds for short-time tests. These show dips (low wear points) at moderate cutting speeds explained qualitatively as due to the interaction of rounding of cutting edge, plowing of asperities, shearing of welded junctions, diffusion, and oxidation. The model of wear is a convincing illustration which can explain satisfactorily such experimental observations as tendency to crater wear in mild steel or differences of wear when steady-state cutting is compared with interrupted cuts as in turning and milling. Weill [22] compares ceramic tools with cemented-carbide tools and finds little difference in cutting forces when machining steel and cast iron, but tool wear of ceramic tools is superior. This is attributed to the absence of metal binders and chemical activity.

Bodart [23] reports an extensive tool-life study carried out in France under industrial and governmental sponsorship which should be of value to anyone interested in tool-life testing and its correlation with microstructure and method of preparation. Tool-life curves are given for various high-speed steels when machining four different grades of steel.

Ham, et al. [24] compare tool forces, power, and tool life at various feeds and speeds for high-strength gray irons obtained from nine different sources. They attempt to establish an empirical correlation between composition and tool life. Optimum cutting speeds lie between minimum-cost cutting speeds and maximum-production-rate cutting speeds according to Siekmann [25], while Gallagher [26], based upon a principle originally stated by Gilbert of the General Electric Company, obtains minimum-cost cutting speeds using a modified formula for minimum-cost tool life and a ratio between this tool life and initial tool life.

Lewis [27] studied the effects of such free-machining aids as sulfur, lead, and graphite in cast iron and cold-worked steels while Becker and Hoff [28], among others, show that, in free-machining steels, flank and crater wear, as well as the machining forces, are decreased when manganese content is increased to 0.65-1.2 per cent. Klein [29] shows experimentally how cutting conditions and tool geometry affect twist-drill life. Colwell [30] studied the effect of cutting fluid in reaming of steels. He shows the effect of built-up edge on the size of the hole and concludes that even a dull reamer under the presence of a good lubricant can produce a good finish and close control of the diameter of the hole. Colwell and Branders [31] discuss a new friction and wear machine as a tool for testing cutting fluids. It is claimed that the test can discriminate between different lubricants.

Cutting-Zone Temperature

In the field of temperature determination of the cutting zone several worthy contributions were made. McFeron and Chao [32] show that analytical calculations of tool-chip-interface temperature can be extended to milling. Apparently the intermittent nature of the process increases the heat flow from the tool-chip interface into the tool when compared with single-point turning. Chao and Trigger [33] present a new noniterative method for calculating the temperature distribution at the tool-chip and tool-work interface. The analysis shows that the tool-work interface temperature increases appreciably with flank wear, but only minor changes occur as a crater is worn into the face of the tool. Trigger, et al. [34] discuss a new compensating circuit which nullifies the parasitic emf introduced by dissimilar lead materials. Test results indicate that the method is reliable. Gaylord, et al. [35] show analytically that the rubbing pair of tool and work considered semi-infinite in extent will produce average potentials. These are the result of nonuniform distribution of contacts over the small area which corresponds to a temperature weighted by the square root of the area on which the nonuniform temperature occurs.

Vibration in Milling

Opitz [36] examined vibration and surface condition on tool life in milling and concludes that the build-up of cutting forces in face milling, as each tooth engages, causes torsional vibration of the arbor. Under resonating vibration conditions, wear of the cutter increases. The author, among others, also shows a range of exciting frequencies and means for placing the torsional natural frequencies above or below the exciting frequency.

Machining Gears

Several papers in the field of machining of gears which might belong in the realm of metal-cutting practice or design are included here because of their analytical nature. Gary [37] gives a summary of gear design and then proceeds to derive an exact solution for obtaining worm-gear-milling-cutter profile and grinding wheel by a stepwise method. Procedures of calculation are given and are claimed to be simple. Thompson [38] investigates the effect of gear-tooth-profile errors produced by three types of hobs in general use, and Martin [39] discusses the effect of undercutting of teeth on gear performance. The latter author develops equations for rack form of cutters which permit determination of values of the amount of undercutting.

Residual Stress

A paper on residual stress by Buehler and Schepp [40] may be of interest. The authors examine the effect on the residual stresses in shrink fits when metal is removed by bore-out and turning techniques. They show how shrink pressures are affected depending on whether a cylinder in a shrink assembly is bored out or turned down.

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NOTE: Since the review committee worked against a deadline and it was difficult to procure some papers, especially Russian translations, in the time allotted, this is not a complete review. Papers not included will be summarized at a later date.

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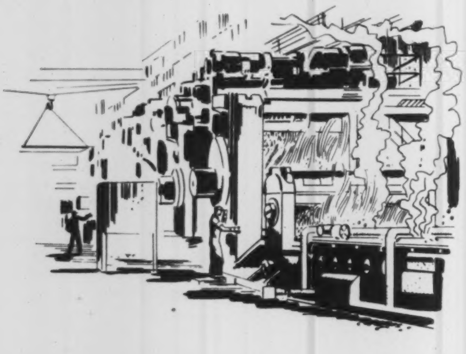

PLASTIC WORKING[8]

By Francis W. Boulger[9]

THIS review covers briefly the subjects of sheet-rolling of metals, cold-working, hot-working, and extrusion.

Sheet-Rolling

Techniques for producing sheet with properties best suited to specialized applications or difficult secondary operations received considerable attention. Twelve papers were presented at one symposium on deep-drawing steel [1].[10] Hindson [2] and McNairn [3] dealt with ingot practices, and Patterson [4] covered the effects of variations in hot-rolling schedules. Southworth and Goettge [5] described the effects of annealing practices. Earlier, Sibakin [6] had published data on the effect of ingot size and rolling schedules on properties of flat-rolled steel products. European papers on the subject were by Cremonese [7] and Edwards [8].

The report by Simcoe [9], first of a series on an extensive titanium sheet-rolling program, covers the effects of ingot homogeneity, chemical composition, and many details of sheet-rolling procedures. Although primarily concerned with titanium alloys, the study will be of interest to producers and users of other sheet materials. Phillips [10] confined attention to the factors affecting the dimensional uniformity of hot-rolled strip steel, concluding that temperature gradients were principally responsibile for gage variations and suggesting how they could be minimized.

In a study of the rolling process from a more fundamental standpoint, Kneschke [11] discussed the hydrodynamic theory of hot-rolling and the effects of various factors on pressures, flow strength, and crack formation. Experiments by Renouard and Bresson [12] led to specific recommendations for producing isotropic sheets from nonferrous alloys having different recrystallization textures. Grigorov and Glokhin [13] showed by x-ray studies that hot-rolled and cold-rolled low-carbon steels have nearly identical textures. They differ, of course, after annealing. Zidek and Dedex [14] describe the practices for producing strips of electrical steel with suitably oriented textures and magnetic properties. Erdmann and Guenther [15] used microradiographic techniques to study the deformation of inclusions produced by rolling aluminum alloys. Intermetallic compounds start to crush and become oriented at small deformations. The extent of crystal orientation is proportional to the amount of reduction. By using etch pits, Gilman [16] directly observed the dislocation movements, of crystals, resulting from plastic working.

Cold-Working

Chambers, Dunn, and Glen [17] published an interesting account of the practices used for blanking magnetic steels to tolerances of 0.0005 in. Recent investigations by Tilsley and Howard [18] produced considerable data on blanking and piercing of sheet metals, establishing the effects of various clearances on blanking and stripping forces. By using proper clearances and small radii on the tools, subsequent shaving operations can be eliminated.

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[8] Condensed from Paper No. 59—Prod-5.

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[10] Numbers in brackets designate References at end of paper.

Taking a metallurgical viewpoint, Murray [19] summarized the properties important for deep-drawing, concluding that considerable experience is still necessary for translating laboratory observations into production recommendations. Grainger [20] surveyed current American and European sheet-forming practices and described those developed recently. Despite the number of articles concerned with explosive forming, quantitative information is sketchy [21]. Neumann's article [22] compared the advantages and disadvantages of drawing and cross-rolling processes for producing cold-worked tubes.

Procedures for making automotive parts by radial draw-forming were described, briefly, by Allison [23]. Incremental deformations are forced to take place successively by using a rotating die, a hydraulic stretch cylinder, and a compression shoe. Fuchs [24] gave details on novel techniques for precision bending of rectangular, thin-walled tubing. Placing the tubes under axial compression shifts the neutral axis toward the outside of the bend. This reduces tension and thinning on the outside wall. Smoother bends are obtained by offsetting the faces of the wiper and form dies by the amount the tube wall will thicken [24]. Szczepinski [25] published a mathematical study of various problems in the theory of stretch forming of sheets.

Warm-Working

Eisenkolb [26] studied the deep-drawing properties of sheet steel at various temperatures. The drawing properties were better at 650 F than at room temperature and poorest at intermediate temperatures. Nachtman and Moore [27] showed that deforming steel bars at around 700 F produced better properties than conventional cold-drawing processes. By suitable combinations of temperature and drafting practices, AISI steels could be produced with higher strengths or with normal mechanical properties and superior machinability. Suppus and Ditter [28] pointed out that hot stretch forming offers advantages over drawing for some aluminum alloys. Higher strengths can be developed in materials which exhibit strain age-hardening.

Experiments by Klyucharev [29] showed that some advantages result from preheating the flanges of blanks before drawing and cooling the walls of the cups during drawing. Preheating lowers the strength of the metal which must be upset during deep-drawing. Cooling the cylindrical walls minimizes thinning.

Hot-Working

Much effort is being devoted to improving forging processes. Kienzle [30] described the special requirements for various subsequent operations and pointed out the benefits of combining cold-pressing and drop-forging operations. Murphy [31] investigated the possibility of producing cheaper high-strength, high-quality gears by various processes. His data permit comparisons of costs and properties of gears made by rotary-forging, cross-extrusion, and precision-forging methods. A novel German forging process [32] using a special press is said to produce gears from 1 to 8 in. in diam suitable for use without machining. Best results are obtained when the pitch is less than 12. Voros [33] theorized that hot-rolling blanks between master gears offers better efficiency than other methods and produces better fatigue properties than machine cutting.

Croan and Rizzitano [34] forged parts at relatively high temperatures and then water-quenched in order to develop optimum mechanical properties in producing closed-die forgings of titanium alloys. Challen [35] reports on methods for producing complex hollow forgings from beta brass. Features of stamping and extrusion processes were combined to produce forgings with cores on different axes.

Extrusion

Extrusion processes for secondary working are of interest to many concerned with unusual materials. Sabroff, Sannicandro, and Frost [36] demonstrated that unalloyed titanium can be successfully cold-extruded to solid and hollow shapes. Coatings, lubricants, and tool designs were found to be particularly important. Others have developed procedures for cold-extruding 1 to 6-in-diam thin-walled molybdenum tubing [37,38]. If the grain size in the hot-worked billet is controlled carefully, yields from billet to tube range up to 82 per cent. Webb [39] has developed an ingenious method of producing turbine and compressor rotors by hot-extruding the wheel around the blade roots that is adaptable to various combinations of materials. It minimizes machining operations and the damping problems troublesome in conventional assemblies. Kovalev and Ryabov [40] reported that the compositions and application techniques of Russian glass lubricants resemble those used in this country.

Recent improvements in the impact extrusion of complicated shapes from aluminum and sintered-aluminum compacts are covered by Quadt [41]. Baugh and Lyons [42] discuss press factors of importance in extruding aluminum and the causes and remedies for streaks. Details are very important in such operations. Flicker [43], for instance, discusses the importance of metal flow patterns and their control. Panko [44] reports that significantly lower friction coefficients and longer lives are obtained from carbide extrusion tooling finished to 4 microin. or better. Ashburn [45] described refined techniques for producing intricate shapes to close tolerances in one cold-extrusion operation.

Galloway [46] reported the effects of slug, wall, and base thicknesses on impact-extrusion forces. In inverse extrusion, the initial and most severe plastic flow occurs in metal adjacent to the base of the punch. Heating copper slugs to 480 F substantially lowered the initial or peak extrusion forces. The loads at maximum punch penetration were not affected by temperature. An intermediate extrusion temperature resulted in uniformly low initial and final loads.

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GRINDING[11]

By George Reichenbach[12]

During 1958, progress in the field of grinding research was uneven. Considerable work was done on such things as vibration and chatter, chip formation, residual-stress measurement, and abrasive wear, but surprisingly little was reported on the very important problem of grinding fluids, whose action is not completely understood.

Chatter in Vibration

An extensive experimental project on chatter and vibration was conducted by Doi [1][13] who constructed a grinding spindle with exaggeration of characteristics which might be expected to cause vibration of the wheel relative to the workpiece. The frequency and amplitude of vibrations were measured with an optical arrangement using mirrors, light beam, and microscope.

Wheel unbalance resulted in a regular vibration at the wheel speed, lagging a short time behind the irregularity, with amplitude increasing as the speed. This was effectively reduced by close bearing clearance.

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[13] Numbers in brackets designate References at end of paper.

Flexibility of the main spindle caused vibrations at a frequency essentially independent of grinding conditions. Changes in shaft speed or depth of cut affected the amplitude but resulted in only small changes of frequency. At high spindle speeds, this vibration disappeared. Workpiece flexibility gave the same result.

The use of a driving belt could give rise to vibrations in two ways: (*a*) The belt tension should be directed in the same direction as the grinding force to keep the spindle bearing at all times on the same side of the journal; (*b*) flapping of the belt could result in poor finish. The frequency here depends upon belt length, mass, and tension. The sleeve bearings were replaced by ball bearings for some of the tests. In general, the ball bearing gave less damping than the sleeve bearing, and allowance should be made for this in the machine design.

Grinding-Chip Formation

In a paper which, through careful measurement, correlates and partly modifies theories of grinding action which had been based on qualitative observations, Backer and Merchant [2] have taken another look at grinding-chip formation. Whereas previous workers have always chosen chip thickness as the fundamental variable for determining grinding action, they suggest that chip cross-section area and chip length taken together form a better basis on which to correlate data. For their experimental runs, it was shown that the specific grinding energy is a function of these two variables plus wheel speed.

They also investigated in some detail the influence of chip geometry on grinding ratio. Over the range of variables considered, the grinding ratio was found to be independent of grinding conditions. This is at variance with most concepts of "soft" or "hard" wheel action. However, as the authors pointed out, the grinding conditions chosen were rather light and bond failure was not likely to occur. The wheel wear was due in large part to gradual attrition of the grits and this was found to depend only on the amount of metal removed.

Residual Grinding Stresses

Residual grinding stresses continued to receive well-deserved attention. Articles by Mueller [3] and Gormly [4] interpreted the earlier work of Tarasov and Letner and reduced it to shop practice. Mueller noted that grinding conditions which produce long wheel life, good finish, and so on, may be just the opposite of those which result in low residual stresses. It is often necessary to effect a compromise. Gormly reviewed the earlier work and emphasized that for 52100 steel the residual stresses are negligibly small in so far as fatigue life is concerned for all practical grinding conditions.

Halverstadt [5] extended the earlier work to the grinding of various high-temperature alloys and found these materials extremely sensitive to residual stresses although the general pattern of stresses is the same. In severe cases the residual tensile stresses were large enough to cause surface checking. It was noted that the use of shot-peening to put compressive stresses on the surface is not practical with these alloys. The surface stresses may cause grain growth when the part is put into high-temperature service. This grain growth greatly reduces the strength. In general, the conclusions were that low wheel speed, small down feed, sulfurized oils, and soft wheels tended to minimize the residual stresses. High work speed reduced the penetration. A short-time anneal did not remove the residual grinding stresses in these materials.

Clorite and Reed [6] made the first study of residual stresses in other than steel alloys. They investigated a wide range of operating conditions and lubricants on the residual-stress pattern in 6Al-4V titanium bars. The stresses fell in the range −11,000 to +109,000 psi. They concluded that with care, however, it is possible to avoid serious stresses with either slow-speed (1800-fpm) or near normal-speed (5500-fpm) grinding. Measurements of grinding ratio were also tabulated and recommendations given for the best choice of operating variables.

Abrasive Wear

Abrasive wear was treated in two papers. The first by Pitblado [7] made a systematic study of the effects of grinding conditions on abrasive belt life. Four different types of failure were noted: (*a*) Fracture of the grains, caused mainly by thermal stresses; (*b*) attrition, caused by chemical attack; (*c*) shelling, the complete removal of abrasive, usually caused by the wrong choice of belt; (*d*) filling or loading, a rare failure experienced only with soft metals. Many grinding conditions were tested. A few of the more significant conclusions were: (*a*) Metal-removal rate is directly proportional to the wheel speed and the normal load on the work; and (*b*) lubrication is very important, the proper fluid increasing life by 300 per cent on most metals and up to 5000 per cent on titanium. It was also noted that atmospheric oxygen is a good lubricant, especially for steel.

The second paper by Ervin [8] took a novel approach to the problem of wheel wear, investigating in detail the chemical properties of silicon carbide. In general, it was noted that silicon carbide can react with oxygen to form many products, but in air the normal reaction leads to carbon dioxide plus silica. The silica usually forms a protective surface film preventing further reaction. However, in the presence of certain glass coatings which dissolve silica the protective coating was not formed and the reaction increased one-hundredfold. However, glasses high in silicates did not dissolve the silica and the reaction arrested itself in the usual fashion. Much more detailed knowledge of this sort on the chemical nature of abrasives would be desirable to help interpret results of grinding tests on various fluid, abrasive, material combinations.

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Abstracts and
Comments Based
on Current
Periodicals and
Events

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BRIEFING THE RECORD

Ultrahigh-Pressure Materials

Future technological progress in the fields of power generation, vehicle propulsion, and many other areas will depend heavily upon the development of improved materials of construction for high-temperature high-pressure service. An article by Charles M. Schwartz and Wendell B. Wilson, "Ultrahigh Pressure for Materials Research," *Battelle Technical Review*, June, 1959, pp. 3–8, reviews some of the research with ultrahigh pressure.

According to the authors, ultrahigh pressure may be used to promote transformations and reactions, and thus to act as a "universal catalyst" for production of new materials. Another important area of application, not discussed in detail, which may ultimately prove of considerable value in materials studies is the use of ultrahigh pressures as a research tool. There is a small but growing amount of research on solids and solid-state theory.

The startling achievements in synthesis, using high pressure, focus attention on the real potentialities for future discoveries. Certainly it will be possible to make new materials, but it will first be necessary to embark on a systematic study of a large number of materials.

Much work is waiting to be done with the pressure-temperature range already available, but each new advance in the hardware will open new horizons.

The application of ultra-pressure research to metallurgy offers attractive possibilities. The production of high-density phases of increased symmetry, the use of pressure to squeeze out voids, vacancies, dislocations, and other crystal imperfections, thus improving the mechanical properties of the materials, are typical examples of the types of improvements to be expected in metal systems.

Effects of Pressure on Liquids and Solids

The effect of pressure on equilibria in condensible (gas) systems, in which the volume change is appreciable has been well established. There is also some evidence of pressure effects on liquids and solids.

A shift toward increased liquid density sometimes occurs and pressure causes a large increase in rate of polymerization of liquid olefins like styrene, probably by forcing the molecules to be favorably aligned.

With solids the bonds are stronger, the densities are higher, and higher pressures are needed to produce physical or chemical transformations. Nevertheless, the compressibility of solids, though small, is finite and measurable. In the case of many elements and compounds which exist in two or more crystalline forms, the high-temperature-stable form is the more symmetrical structure, and consequently its atoms are most closely packed.

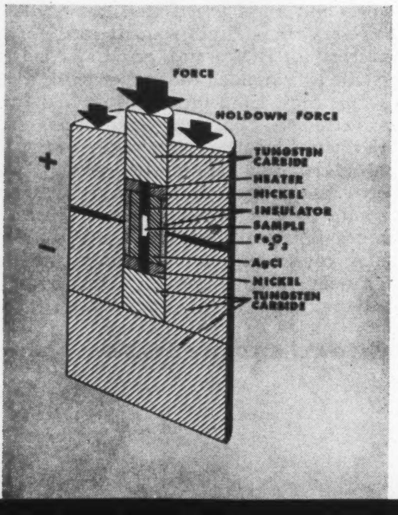
In a few instances, chemical additions stabilize a high-temperature form so that it is retained at a lower temperature. Adding a few per cent of lime or one of the rare earths to zirconium dioxide stabilizes its high-temperature cubic structure, producing a material which does not transform on heating and is free from the effects of spalling or cracking due to phase transformation. It might be possible, with high enough pressure, to transform some solids into more dense forms not observed in nature.

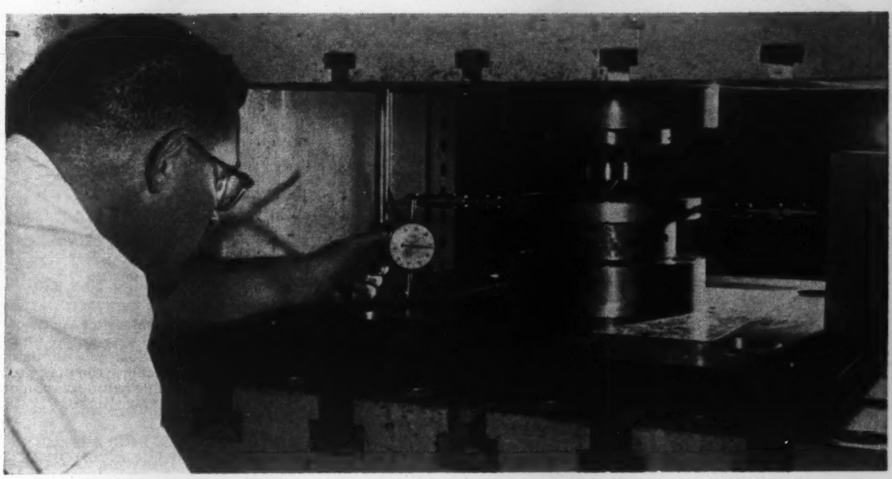
Although most natural phase transformations are reversible with temperature change, fortunately, there are many transformations known to be so very sluggish that if the high-temperature form is cooled with sufficient speed it is retained in a metastable condition. The diamond is a classical example. It is metastable and reverts to graphite on heating. However, this reverse transformation is exceedingly sluggish, and diamond is normally considered a relatively stable material. Thus there is evidence that high-pressure phases, once synthesized, would exist metastably over a useful temperature range and for a sufficient time to be of some use.

Most reactions to form materials, as in the synthesis of diamond, would be much too sluggish at room temperature to be of economic value, and heat must be used simultaneously with pressure. This requirement imposes a severe restriction on design of apparatus.

What pressure might be needed to cause transformations in refractory solids? To cite a natural phenomenon, the calculated pressure at the interface between the core of the earth and the mantle is over 15 million psi. Even at a depth of only 250 miles below the surface, the pressure is greater than $1^1/_2$ million psi. This value must be attained or exceeded, and at elevated temperature to simulate geological processes in the laboratory.

A right-circular-cylinder-type die produces pressures up to 750,000 psi in combination with very high temperatures





A modified Bridgman anvil, known as the "girdle," which provides internal heating, is being investigated at Battelle

Ultrahigh-Pressure Apparatus

P. W. Bridgman of Harvard has spent many years in the design of high-pressure equipment and in the study of its effects on the properties of materials. The bulk of his work was conducted in liquid-pressure vessels devised to provide truly hydrostatic compression to 450,000 psi essentially at room temperature. His studies provided data on compressibility and changes in electrical resistivity useful for detecting any transitions that might occur under pressure. More recently he has developed apparatus suitable for pressure research beyond 1,500,000 psi.

Bridgman's work was extended by others, with emphasis on synthesis. L. Coes, Jr., of the Norton Company, and later, H. T. Hall of the General Electric Company, devised methods of simultaneously obtaining high temperature and high pressure. The former produced coesite, a dense form of silica, not found in nature. His apparatus consisted of a cylinder die of hot-pressed alumina, with a cemented-carbide piston. The GE work culminated in the production of diamond and of Borazon, a cubic form of boron nitride (Mechanical Engineering, April, 1957, pp. 357-358). Details of the apparatus are not available.

A massively supported piston was employed by Bridgman in his "anvil" unit. The Battelle version of this apparatus consists of two abutting pistons of cemented carbide, with one or both working surfaces in the form of a flat truncated cone. The sample is in the form of a thin disk, about 10 mils thick, placed within a gasket ring of talc-like pipestone. External heat is supplied from a tube furnace surrounding the pistons. Pressures to 3,000,000 psi have been obtained with this apparatus, at room temperature. Temperatures up to 1000 C have been used, but owing to loss of strength of the die materials, the available pressure is not over 300,000 psi at this temperature. The Bridgman anvil, supported under hydrostatic pressure in his 450,000-psi apparatus, reached 6,000,000 psi. This value is higher than that predicted on the basis of the results using the cylinder die under hydrostatic pressure. It is believed that the combination of massive support and hydrostatic pressure interact to give increased strength.

An Artificial Mineral

Coesite, the high-pressure form of silica, obtained by Coes, has a density of 3.01 g per cm, compared to 2.65 for quartz. It was prepared from silicate and mineralizer at 525,000 psi and 750 C. It is intriguing to speculate why coesite is not found in nature, for these conditions are certainly readily available in the earth's interior. The answer may lie in the unknown relation of the cooling rate to the rate of pressure release. In order to retain a high-pressure, high-temperature phase as a metastable phase at room temperature, it is necessary to cool first, while under pressure, before releasing the pressure. A number of other natural minerals, most of them siliceous, have been synthesized in the laboratory through the use of high pressure and elevated temperature. These include garnets, silimanite, kyanite, and topaz. In Battelle's laboratory, studies of the uranium-oxygen system have led to the discovery of a new form of U_3O_8, whose properties are as yet unexplored.

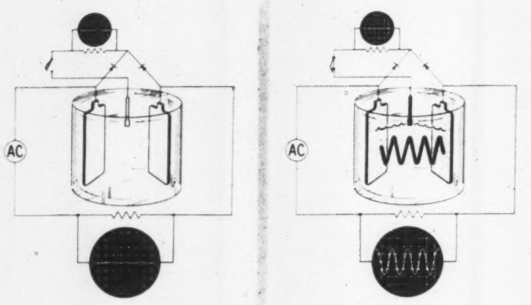
Radiation Effects on Steel

The General Electric Company and United States Steel Corporation are carrying out the first large-scale investigation of radiation effects on steels to be made in a private test reactor and wholly financed by private industry.

New steels with superior properties which will help reduce the capital and operating costs of nuclear power plants are being sought. Corrosion resistance of a wide variety of steels is being carefully investigated under conditions simulating those in actual boiling-water-reactor service.

The effects of high-intensity neutron irradiation on the properties of reactor-pressure-vessel steels will also be studied. It is known, at least qualitatively, that although the strength and hardness of metals, including steel, increase as a result of neutron irradiation, ductility and toughness generally decrease. Therefore it is essential that the extent of the decrease in ductility and toughness properties of these steels be determined for neutron exposures equivalent to those expected during the service life of the vessel.

Since there is some evidence that the change in mechanical properties is brought about through a change in microstructure of the steel, an investigation of the mechanism of the radiation damage will be carried out.



OFF CONDITION ON CONDITION

The Ovitron, a nonmechanical switching device, consists of two load-connected electrodes and a grid control element all immersed in an electrolytic bath permanently sealed and encapsulated. By using a variable resistor instead of a switch—as shown schematically—the magnitude and potential of the control signals can be controlled to achieve modulation of the load circuit.

"Ovitron" Switching Device

"Ovitron," a nonmechanical switching device capable of switching almost any amount of a-c continuously without wear, disintegration, or loss of efficiency has been introduced by the Ovitron Corporation, Detroit, Mich.

The device consists simply of two load-connected electrodes and a grid control element all immersed in an electrolytic bath permanently sealed within an encapsulated container. Upon the application of a small energy stimulus introduced through the grid element, the semipermeable surface of the two load electrodes becomes permeable to certain ions and is instantaneously changed from a nonconductive to a conductive state—thus allowing large amounts of a-c to flow from one electrode to the other through the medium of the electrolyte.

The high-wattage load current is controlled entirely by the small energy stimulus, and in a manner which permits either full-on, full-off switching, or modulation to occur. Moreover, modulation can be of the continuous type without harmful effects on the unit or its operating characteristics.

When the control signal is removed from the grid control element—or when another signal of opposite polarity is applied—the conductive surfaces of the load-carrying electrodes are immediately restored to their original nonconductive state, thereby effectively blocking the flow of current through the unit.

Both load-carrying electrodes are coated with an oxide film. This causes them to act in the circuit much as rectifiers back-to-back, and prevents current from flowing through to the load. Upon application of a small d-c potential to the grid control element, the two electrodes are polarized and metal ions are forced into the structure of the oxide film which changes the film from a nonconducting to a conducting state. Thus the load now "sees" two conducting electrodes and current passes between them. There are, of course, other effects as well—chiefly, the double-layer capacitive effects of the charges collected at the electrodes.

It can be seen that the chief function of the electrolyte is to bridge the two load-connected electrodes and conduct the flow of current between them when their surfaces are in the conductive state, thus serving the same purpose as a solid piece of wire in conventional devices. Its other function, of course, is to provide convenient, instantaneous means for polarizing the two electrodes from the grid element. In this connection, however, it should be understood that there is no change in the ionic state of the electrolytic medium during conduction—nor does the electrolyte have any transducing characteristics of its own—nor is its use based in any way upon solion principles.

Both load electrodes and the grid control element are impervious and nonreactable to the electrolytic bath and show no indication of dimensional change, disintegration, or internal change with age or continuous repeated operation.

The grid element has a redox relationship with the two load electrodes which is expressed by the control current. During operation of the unit, small amounts of gases are formed by the grid-control current only—not by the load current. By utilizing a catalyst, these gases are returned to solution—thereby achieving a self-regenerative process within the device which prevents depletion of the electrolytic fluids. When the unit is off, the redox relationship of the metal ions to the two load electrodes is performed in such a manner as to maintain an equilibrium system in which no gases are formed.

Small amounts of gases formed by the grid-control current only—not by the load current—are returned to solution by utilizing a catalyst, thus preventing depletion of the electrolytic fluids. No gases are formed when the unit is off.

The devices are unaffected by vibration, shock, impact, moisture, or position and are uninfluenced by temperature variation.

In laboratory tests for functional use, Ovitrons have been applied as proximity switches, logic devices, circuit breakers, error detectors, modulators, amplifiers, regulators, and time delays. Load voltages range from 3 to 70 volts a-c, and load currents from milliamperes to 15 amp.

Stroboscopic Vibration Analyzer

The National Bureau of Standards has developed a stroboscopic vibration analyzer for determining the amplitude and phase relations of vibrations of any frequency.

Signals from vibration pickups are mixed with a common signal of slightly differing frequency. The difference signal is then filtered from the combined frequency and displayed on an oscilloscope. The analyzer can be used to observe vibrations in bodies of any size, and for vibration amplitudes from the submicroscopic to the visible.

Materials Briefs

▶ Lead and Powder-Metal Alloys

"Lead-cemented" alloys made by mixing molten lead with finely divided solid particles of other metals or materials have been prepared in research sponsored by the Lead Industries Association, at Battelle Memorial Institute, Columbus, Ohio. The alloys combine the properties of both lead and the second substance, and may be useful in such applications as stopping gamma rays for nuclear-radiation shielding when boron is added.

Lead with increased strength gained by adding other metals might be useful where corrosion-resistant materials are required. Gaskets, for use at temperatures where plastic gaskets would burn, and automobile and rotating-shaft bearings are other possibilities. Lead's softness, sometimes a disadvantage, can be an asset when serving as a binder for less ductile materials like tungsten.

To overcome the tendency of the mixture to become sluggish when large amounts of powdered solids are added to molten lead, a revolving crucible was designed resembling a cement mixer. Most metals resist being stirred into molten lead, and special pretreatment of these powdered metals and special mixing techniques were devised. After the hot mixtures were poured into molds for quick hardening, the molds were vibrated to minimize porosity.

The Battelle investigators found that at least six metals are particularly well suited for the new alloys—cobalt, copper, iron, molybdenum, nickel, and tungsten. Experiments show that the size and shape of the metal-powder particles, as well as the amount, affect the final material.

▶ New Adhesive for Rubber-to-Rubber Bonding

An adhesive for heat bonding dissimilar unvulcanized elastomers is available for evaluation from the Special Products Division, Lord Manufacturing Company, Erie, Pa. Designated as Adhesive EX-B150-1, it is said to be the first successful adhesive to give rubber-to-rubber bonds between elastomer combinations previously thought impossible.

Typical applications include bonding conveyer-belt covers to bodies, wire and cable jackets to insulation, hose covers, roll covers, and multilayer gloves.

Rubber-tearing bonds are produced which resist aging and retain high strength after prolonged flexing. The adhesive fills a particular need when one of the stocks involved is based upon butyl rubber. In many cases it will produce good bonds even if one stock is cured.

When used with a primer, it bonds rubber stocks to many other substrates such as plastics or metals.

▶ Beryllium Sheet Successfully Fabricated

Structurally sound beryllium sheet material has been successfully fabricated by the Martin Company's Baltimore Division. All previous forms of beryllium—castings, forgings, rolled sheet, and others—have exhibited nonuniform properties and brittleness.

Use in basic airframe structures will permit solution of many of the aerodynamic and structural heating problems associated with space flight and re-entry of the earth's atmosphere at speeds up to 18,000 mph.

The project was accomplished under an Air Force contract. Development and fabrication were performed in conjunction with Nuclear Metals, Inc., Concord, Mass.

▶ Regulating Heat Absorption by Color Shifts

A coating that will change color to control the heat-absorption and radiation qualities of the skin of a satellite has been devised by Space Technology Laboratories, Inc., Los Angeles, Calif. As the internal temperature of the satellite increases, its skin would become light in color to increase reflectance, or become dark as the internal temperature takes a downward turn.

The coating can be either a paintlike substance or a plastic applied in several layers. About 35 substances have been found to have this "chameleon" ability at the required temperature levels. One particular coating changes from red to yellow with increasing temperature. In the case of polymer compounds, use is made of the reversible transition from the sol state to the gel state as the temperature increases.

A host of applications for temperature control in homes, autos, airplanes, and other uses come readily to mind. It is not too fantastic to think of treating cloth with such a substance for far more comfortable clothing. Such mundane items as sunglasses with automatic light control and glass walls which would in effect have blinds built right into them are just a few of many possible uses.

The importance of protecting satellite payloads from temperature extremes was dramatically brought home when some of the instrumentation in the Pioneer I failed as the result of an unexpected slight shift in course which caused temperatures to change.

▶ High-Ductility Molybdenum Sheet

Pure molybdenum sheet with greatly improved ductility is available in commercial quantities from General Electric's Lamp Metals and Components Department, Cleveland, Ohio. Erickson cup tests show as much as five times the ductility of ordinary "moly" sheets.

Where ordinary sheet will bend only about 20 deg at room temperature before bending or cracking, HD (for high-ductility) molybdenum sheet will bend 90 to 180 deg without failure. There is also far less tendency to delaminate on punching, stamping, and shearing than with ordinary commercial grades. Benefits of this new product are of particular significance in thicknesses from 0.025 to 0.125 in.

Where 1000 F has been needed for forming many molybdenum parts, the new high-ductility sheet can now be bent at right angles or double upon itself at room temperature, and may make possible the forming of thick sections of sheet by Hydroforming techniques in which heat cannot usually be used.

▶ New Alloy Resists Molten Fluoride Salts

A new nickel-base alloy, developed as a container material for molten fluoride salts at high temperatures is in developmental production by Haynes Stellite Company, Division of Union Carbide Corporation. Called "Hastelloy" alloy N, it evolved from work done at Oak Ridge National Laboratories.

The alloy resists embrittlement upon continuous exposure up to 1600 F service temperatures. Tests have shown sufficient oxidation resistance in air for continuous operation at 1800 F. Intermittent operation at temperatures to 1900 F may also be possible, depending on other conditions. Alloy N has good weldability and can be readily forged. The hot-working range is between 1600 and 2150 F. It has been extruded and produced in the form of high-quality seamless and welded tubing.

A new desk-top analog computer being used without readout equipment

Desk-Top Analog Computer

A basic analog computer which sells for less than $4000 and occupies little more desk-top area than a standard electric typewriter has been introduced by Electronic Associates, Inc., of Long Branch, N. J.

Known as the PACE TR-10, the computer weighs only 80 lb, operates on 50 or 60-cps 110-volt current, consumes only 50 watts, and is reliable and accurate (0.1 per cent). The compact size of the fully transistorized unit was made possible by the company's design and development of a new transistorized d-c amplifier. Two of the amplifiers, packaged as a single shielded unit occupy only a $1^1/_2 \times 5 \times 6^1/_2$-in. space.

The TR-10 has been designed to provide analog computation at the engineer's fingertips for the solution of problems whose magnitude or complexity does not justify the use of a large, general-purpose, precision analog computer.

The basic model has 10 attenuators, six summing amplifiers, and four integrating amplifiers. It is capable of computing 10 additions or subtractions, four integrations, or 10 parameter adjustments. Modular linear and nonlinear components can be added until all of the available space in the console is occupied. In problems where a constant value is the solution desired, the computer can be used without read-out equipment, the nullmeter on the control panel providing an acceptable answer. Where dynamics are involved, two-channel strip-chart recorders are available as low as $1250. An *x-y* plotter is available for $1850.

Machine Translation

Translation by machine has now progressed to what might be called a "dictionary-lookup" basis.

The first problem in mechanical translation is to prepare a dictionary, and this has been done at several centers according to the *Industrial Bulletin* of Arthur D. Little, Inc. There is a heavy emphasis on Russian, for which there is an obvious demand. One such dictionary, or word file, comprises six reels of magnetic tape and contains over 20,000 entries, representing over 10,000 distinct Russian words, plus their various grammatical forms. Dictionary entries can be prepared a number of ways—to include, for instance, a list of all the alternative English translations, as well as certain coded information telling the job the word performs in the sentence. Here is one possible example:

притяжение	ADHESION	NDIIN100
	ATTRACTION	
	GRAVITY	

The human translator handling such a machine result would know that, for the Russian word притяжение, there are three possible English translations; it would be up to him to choose the best alternative. As an aid in his task, the code number tells him that the word is a noun (N), that it can be declined (D), that it belongs to a certain subclass of inanimate nouns (I1), that it is of the neuter gender (N), that it is singular (1), and that it has no special forms (00).

The next step is to program a general-purpose computer so that it will accept a Russian text and the Russian-English dictionary file, process the text, and print out a word-for-word translation. Text entries are prepared by specially trained typists who use a double-keyboard machine containing both Russian and English characters. They type the Russian text at sight, in Russian characters, and use the English characters to note special points, such as formulas, paragraphs, quotations, and so forth. (Interestingly enough, the best typists for this purpose are those who don't know Russian; they aren't bothered by the problem of understanding!)

The computer works on its input to produce a series of dictionary entries like that given above. Russian words in the original, however, may be transliterated automatically into the corresponding English characters, according to accepted standards—thus N for the Russian Н, YE for Е, and T for Т. Finally, the product is turned over to a human post-editor who, with a little practice, can turn out a passable English version of the original text. Here is an example of a word-for-word translation and the post-editor's work:

PREDSTAVLJA-ET	BOL'SH-OI	INTERES-
TO PRESENT	BIG	INTEREST — - - -
IT ~~TO~~ OFFERS	LARGE	PROFIT
TO PRODUCE	GREAT	IMPORTANCE
TO REPRESENT	HEAVY	
TO INTRODUCE		

But it is obvious that a human translator—the post-editor—still has a lot of work to do. He must decide when the smaller auxiliary words are needed, when to leave words out, and whether to supply a specialized translation even beyond the vocabulary of the machine. Often, to produce a smooth English translation he must follow, unconsciously, such rules of grammar and syntax as the following: If a Russian noun A is followed by another Russian noun B, and the noun B appears in the genitive case, render the translation (in English) "the A of the B." And so on.

The procedure is onerous and, even when carried out, gives a product that is hard to read. Obviously, it would be much easier to do the whole business by machine, but first it will be necessary to devise relatively simple rules for translation of groups of words, expressed in machine language. As a first step, much current research effort is being devoted to more precise formulation of rules of grammar and syntax and to schemes for handling idioms.

There is at least one proposal for using the computer itself as a language-research tool. This has been called the "trial translator"—actually a set of machine programs for testing previously formulated rules by applying them automatically to a larger body of Russian text. For instance, a computer could be programmed to hunt for all combinations in the available text of the general type: noun (nominative case) followed by another noun (genitive case)—and print them all out for human inspection. The trained linguists could decide whether the basic rule first proposed is really valid, and if not, modify it and retest it. One obvious advantage of the trial translator would be that many examples could be discovered by the machine in far less time than it would take a human reader. And by the successive operations of formulating a rule, trying it out, improving the rule, there should result a constant improvement in the quality of machine translations.

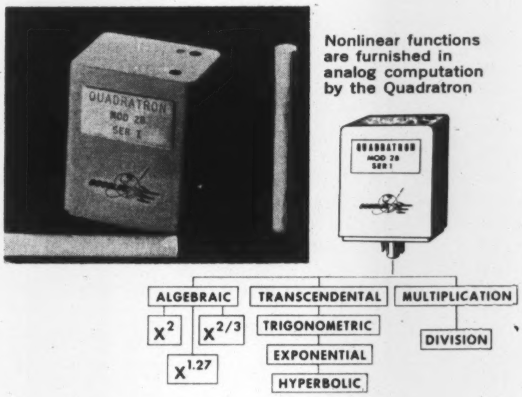
Perhaps machines will never be able to produce smooth, fluent, idiomatic translations of any texts fed into them (especially of poetry), but they are already invaluable aids in hurdling the technical-language barrier. And one valuable by-product will be considerably improved knowledge of Russian (and English!) grammatical structure.

Miniature Nonlinear-Function Computer

A MINIATURE computing unit called a Quadratron, and regarded as a major advance in simplifying electronic computer systems, furnishes nonlinear functions in analog computing. Developed by Douglas Aircraft Company, and not much larger than a cigarette lighter, it is capable of replacing a system more than 700 times its size which costs thousands of dollars more.

The Quadratron is used to multiply a voltage by itself and can provide some 25 of the most basic and commonly used nonlinear functions. The square and the cube are mathematical building blocks whose availability makes it possible to generate other powers whether they are whole numbers or not. Thus unique approximations to useful functions can be obtained, such as

$$(ax^2 + bx)^{1.43}$$



Nonlinear functions are furnished in analog computation by the Quadratron

The simplicity and reliability of Quadratron also suggest a wide variety of uses in control systems, automation, analog computing, instrumentation, simulation, and data reduction.

Heat-Storage Research

HIGH-TEMPERATURE storage, charged with resistance heating properly controlled, offers the most immediate promise as a means of smoothing load curves with either heat pump or other electric-heating systems, according to a report by the Battelle Memorial Institute, Columbus, Ohio.

The report emphasizes that the application of heat pumps for heating residences is certain to grow as the demand for year-round air conditioning increases. The resulting electrical-load characteristics under the present practice of using supplementary resistors will not be favorable from the viewpoint of electric utilities when heat-pump usage is substantially saturated.

Battelle, and Comstock and Wescott, Inc., were engaged by the Joint Heat Pump Committee of the Association of Edison Illuminating Companies, and the Edison Electric Institute.

Comstock and Wescott's report recommends that future research and development work which might yield a practical method of heat storage—no apparatus requiring only "design engineering" has yet been discovered—should be directed to the simultaneous study of three classes of systems plus a study to increase the effectiveness of insulation in order to reduce its volume. A specific system was selected from each class which seems most promising.

A limited number of copies of the reports are available upon request to the acting secretary of the Joint Heat Pump Committee, Edison Electric Institute, 750 Third Ave., New York 17, N. Y.

Heat-Storage Systems Recommended for Future Research

Class and materials recommended for initial study	Temperature at which system is maintained	Approximate volume, cu ft per million Btu: Materials only	Approximate volume, cu ft per million Btu: With insulation and equip	Heat source	Relative safety (see note)
Hydration					
Calcium oxide and liquid water......	810 F	10.3	24.4	Heat of hydration and sensible heat	B
Fusion					
Sodium hydroxide..	605 F	24.7	35.3	Heat of fusion and allotropic change plus sensible heat	B
Chemical change					
Magnesium hydride....	Room	9.3	23.0	Reaction of hydrogen and air	C

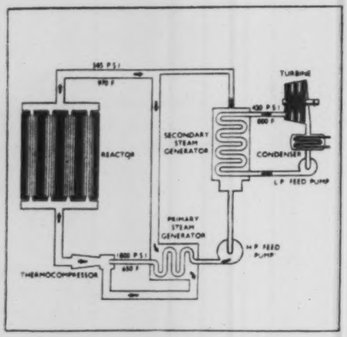
NOTE: Relative safety ratings used in report: (materials having ratings A and D are not included in this article).

A Nontoxic, noncombustible materials at temperatures below that of boiling water.

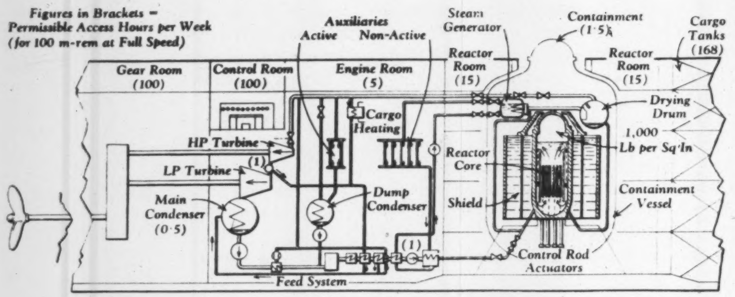
B Solids, or nonvolatile liquids stored below the living level of house, at temperature not over 1020 F.

C Systems using combustible gases.

D Reactive or toxic volatile liquids—hazardous.


585 P.S.I.
970 F
TURBINE
430 P.S.I.
800 F
SECONDARY STEAM GENERATOR
REACTOR
CONDENSER
L.P. FEED PUMP
PRIMARY STEAM GENERATOR
H.P. FEED PUMP
1800 P.S.I.
650 F
THERMOCOMPRESSOR

Flow diagram of the proposed Vickers steam-cooled heavy-water-moderated nuclear-ship-propulsion unit


Figures in Brackets = Permissible Access Hours per Week (for 100 m-rem at Full Speed)
Auxiliaries
Active
Non-Active
Steam Generator
Containment (1·5)
Cargo Tanks (168)
Gear Room (100)
Control Room (100)
Engine Room (5)
Reactor Room (15)
Reactor Room (15)
Cargo Heating
Drying Drum
HP Turbine
LP Turbine
(1)
1,000 Lb per Sq In
Reactor Core
Main Condenser (0·5)
Dump Condenser
Shield
Containment Vessel
(1)
Control Rod Actuators
Feed System

A complete nuclear-propulsion unit with guaranteed performance is proposed by AEI-John Thompson. Using a direct-cycle boiling-water reactor and geared turbines, its fuel would cost 0.290 pence per shp compared with 0.384 for oil.

British Nuclear-Ship Proposals

Eight feasibility studies on a variety of nuclear-ship-propulsion methods have been submitted to the Admiralty according to the British journals *Engineering*, *Nuclear Engineering*, and *The Overseas Engineer*.

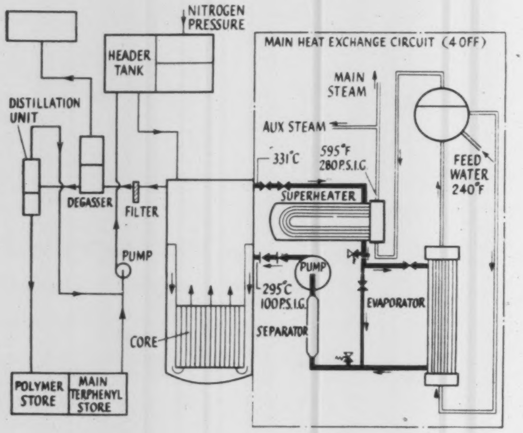
In addition to their use in ships, most of the designs would also lend themselves to use in 15 to 50-emw land-based plants, a size likely to be in great future demand in many countries.

The AEI-John Thompson Nuclear Energy Company, Ltd., has proposed a boiling-water-reactor unit that could be built in 30 months. Certain core components, based on the American Vallecitos and Dresden plants, would be purchased from General Electric (U. S.). The reactor would be capable of operating 380 days at full power and refueling in 100 hr.

The Babcock & Wilcox, Co., Ltd., submitted a pressurized-water design similar to that for the *NS Savannah* but producing 2$^1/_2$ times as much power while occupying only 20 per cent more space. The 500-day full-power capability would be the equivalent of two to five years of normal service.

De Havilland Engine Company, Ltd., would use a high-temperature gas-cooled reactor similar to that being developed by the U. K. Atomic Energy Authority in association with the Organization for European Economic Cooperation in the Dragon project at Winfrith Heath. Twin reactors, capable of operating independently, would be fueled with a mixture of uranium and thorium carbide bonded into graphite pellets and contained in sealed impermeable graphite.

Flow diagram for the Hawker Siddeley organic-moderated-reactor proposal which would have the lowest cost per shp of any reactor


NITROGEN PRESSURE
HEADER TANK
MAIN HEAT EXCHANGE CIRCUIT (4 OFF)
MAIN STEAM
DISTILLATION UNIT
AUX STEAM
331°C
595°F
280 P.S.I.G.
FEED WATER 240°F
DEGASSER
FILTER
SUPERHEATER
PUMP
PUMP
295°C
100 P.S.I.G.
EVAPORATOR
SEPARATOR
CORE
POLYMER STORE
MAIN TERPHENYL STORE

The General Electric Company (British)—Simon-Carves atomic-energy group would follow the gas-cooled, graphite-moderated-reactor "tradition," adding a secret fuel-element design that would make possible a much greater specific-power rating.

Hawker Siddeley Nuclear Power Company, Ltd., urge an organic-moderated reactor which has largely been developed to date by Atomics International (U. S.). This would have the lowest cost per shp of any reactor and an operating cost for a 40,000-ton tanker only 5 per cent above conventional fuel.

A company group formed by Mitchell Engineering, Fairfield Shipbuilding and Engineering, and Combustion Engineering (U. S.) would use the closed-cycle boiling-water reactor with nuclear reheat. A ship could be ready in 36 months.

Vickers Nuclear Engineering Company, comprising Rolls-Royce Limited, Foster Wheeler Limited, and Vickers-Armstrong Limited, propose a novel system in which heavy water would be the moderator and steam the coolant. The system would be designed for ship propulsion from the start. Since it would have a minimum of moving parts, it would be peculiarly insensitive to accelerations imposed upon it by the movements of the ship or attitude of the plant. The fluid-control system would permit shutdown independent of external supplies and irrespective of the position of the reactor. The steam coolant would flow in a closed primary circuit (with thermocompressor self-circulation) and propulsion steam would be generated in a second circuit.

The U. K. AEA proposes a modification of the Advanced Gas-Cooled Reactor now being built at Windscale. The 100-mw heat rate of the reactor corresponds to about 35,000 shp. A number of methods would be used to reduce the size of the reactor, but few details are fixed, since the Advanced Gas-Cooled Reactor itself is still in the development stage.

According to *Engineering*, it is likely that more than one scheme will mature—a tried conventional design at an early date, an advanced system late in the 1960's, and others at intermediate stages.

Saline-Water Conversion

The development of practicable low-cost means of producing fresh water from sea water or other saline waters was provided for in the Saline Water Act, passed by Congress in 1952 in view of an acute shortage of water in arid regions and the excessive use of underground waters. The act provided for the Department of the Interior to undertake research, make grants, and co-ordinate work on the subject. The original small program was extended in 1955 to a $10-million 14-yr program.

Laboratory and economic study of the many possible processes has narrowed the field to five broad groups: (*a*) Distillation through artificial heat; (*b*) solar-heat distillation; (*c*) separation of salt by membrane processes, of two or possibly three kinds; (*d*) freezing; and (*e*) other chemical or electrical means of separation, including solvent extraction. The various potential processes are suited to different conditions, as they offer partial answers to the complex over-all problem of providing fresh water from different saline sources, in different locations, for different uses, and in various quantities. Some may be best adapted to supply of an individual farmstead or home, others to furnishing millions of gallons per day to a city or an industry.

The most promising of the conversion methods now under development, according to the Department of the Interior, include several distillation and membrane-separation processes, and one form of salt-water separation by freezing. For these, some pilot-plant work is already in progress. Other processes, still in the laboratory, are recognized as justifying further investigation.

LTV Process. In March, 1959, the long-tube vertical multiple-effect distillation process, LTV, was selected from 17 separate processes, and a contract for a $50,000, 1-mgd demonstration plant was awarded the consulting-engineering firm of W. L. Badger and Associates, Ann Arbor, Mich. The firm has been operating a pilot plant using this process since 1957 at Harbor Island, N. C. This is the first of five demonstration plants that will be built by the Office of Saline Water. Three plants, designed for the conversion of sea water, will be located on the east, west, and Gulf coasts. Two plants for the treatment of brackish water will be located in the arid areas of the southwest and the northern Great Plains. The remaining processes will be selected at three-month intervals.

The LTV process consists of a vertical nest of tubes with heating steam outside and the liquor inside the tubes. The feed enters at the bottom and starts to boil part way up the tubes. The evolution of vapor gives a very high velocity to the mixture. The heat-transfer coefficients obtained are quite satisfactory, ranging from about 200 to 1000 Btu per hr per sq ft per deg F, depending on conditions. The top of the tube bundle is surmounted by a vapor-liquid disengaging space. The liquor usually passes only once through the tubes of any effect and no liquor level is maintained in the vapor head. Thus the residence time of liquor in any effect is only a few seconds.

Multistage Flash Distillation. The second sea-water-conversion demonstration plant will be a 1-mgd multistage flash-distillation process that may use a low-temperature nuclear reactor as heat source. In flash distillation, sea water is progressively heated and then introduced into a large chamber where a pressure just below the boiling point of the hot brine is maintained. When the brine enters this chamber the reduced pressure causes part of the liquid to immediately boil—or flash—into steam. The remaining brine is passed through a series of similar chambers (multistages) at successively higher vacuum where the flash process is repeated at progressively lower temperatures.

The progressive heating is accomplished by piping the incoming sea water through the flash chambers, starting at the low-temperature end. In each chamber the flashed vapor condenses as it gives up its heat to the sea water. The condensed vapor is the product water of the plant. Final heating of the sea water, before flashing, takes place in a salt-water heater.

Solar Stills. An experimental deep-basin solar still for sea-water conversion was also completed in March. It is the first of three solar stills that will be tested and developed by the Battelle Memorial Institute of Columbus, Ohio, at a seashore solar-research site near Port Orange, Fla. The deep-basin, glass-covered still, designed by George O. G. Löf of Denver, Colo., covers an area of 2500 sq ft. This is of sufficient size to allow evaluation of engineering features and obtain reliable data on construction, operation, and maintenance costs.

The two other stills provided for in the contract are nearing completion at the Florida station. One will cover an area of 500 sq ft, and the other 2500 sq ft. Both stills are of shallow-basin design and make extensive use of plastic materials.

Under a co-operative agreement, E. I. du Pont de Nemours & Company has supplied the basic designs and plastics materials for the two shallow-basin stills. The larger one uses weatherable Mylar as a cover material, and the smaller still has a cover of experimental film designated as type R.

The still consists of black-bottomed basins with transparent covers. The vapor produced from sea water in the bottom of the basins condenses on the inside of the transparent cover and runs down to channels at the edges of the basin for collection. The three stills are expected to produce a total of about 500 gal of fresh water per day.

Automobile Outpricing Itself

The automobile will "outprice itself as a home-to-work vehicle and become a grocery wagon and sports car," under the prohibitive disadvantages of rising list prices and mounting charges for fuel, service, insurance, and parking, according to Marvin O. Anderberg, chief engineer of the Seattle Transit System. Speaking at the Summer and Pacific General Meeting of the American Institute of Electrical Engineers, Mr. Anderberg predicted that "the breakthrough is undoubtedly coming when convenient, low-cost, expeditious, socially acceptable local and rapid transit will receive the financial support it needs."

Micrometer for ±0.000010 in.

An ultraprecise micrometer with a 4-in-diam barrel accurate to ± 10 millionths of an inch per inch is made by the Sheffield Corporation, Dayton, Ohio, a subsidiary of the Bendix Aviation Corporation. It is available in two standard size ranges, 0 to 1 in. and 0 to 2 in.

To insure the accuracy and high-quality performance of each micrometer, the lead screw, nut, and barrel are calibrated as an integral part and the serial number is registered.

PHOTO BRIEFS

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1 Nuclear Cruiser. The Navy's first nuclear-powered surface ship, the cruiser **Long Beach**, is being completed at the Quincy, Mass., yard of Bethlehem Steel's shipbuilding division. It will have two Westinghouse-designed pressurized-water reactors.

2 Beryllium Heat Sink. An 80-in-diam, 3-in-thick, saucer-shaped beryllium disk has been forged by Alcoa for the NASA man-in-orbit program from a 62-in-diam powder-metal billet supplied by Brush Beryllium Company. The disk will be the leading face and will store and dissipate the great heat of re-entry. Workmen wear aluminized suits.

3 Fiber-Glass Pavilion. Five of 90 hexagonal umbrella-like laminated-fiber-glass building units are erected for 60-mph airplane-wind-blast tests at Mitchell Field, N. Y. Each of the 19-ft columns constructed by Lum Laminates, Inc., for the 15,000-sq-ft pavilion of the American National Exhibition in Moscow had six "petals" bolted into position. Cranes raised completed columns into prepoured concrete.

4 Heart-Lung Machine. Heart and lungs are immobilized during surgery by artificially circulating and oxygenating blood with a DeWall-type bubble oxygenator. The clear vinyl-resin plastic tubing, made of B. F. Goodrich Geon, is nontoxic, chemically resistant, and unaffected by autoclave sterilization.

5 Ultrasonic Gaging. When the transducer of a Branson Instruments, Inc., ultrasonic-resonance gage is placed against one (outside) surface of a missile nose cone, high-frequency mechanical vibrations are transmitted into the metal. Wall thickness—which must be held to ±0.006 in.—can be read directly from a scale placed in front of the cathode-tube display.

6 Ultrasonic Pulse Measures Temperature. Quartz probes which extend into the flame of a plasma generator developed by Avco Research and Advanced Development Division, Wilmington, Mass., transmit and receive sound impulses which are converted to temperature measurements. The generator produces 12,000-F temperatures for general laboratory and production use.

7 Rotor Slotter. The rotor of a 150,000-kw steam turbine-generator for the Enrico Fermi Nuclear Power Plant, Laguna Beach, Mich., is being slot milled in Allis-Chalmers shops. The conventional 1800-rpm unit will operate at 850 psig, 780 F, and 1-in-Hg-abs exhaust pressure.

8 "Crab" Fork Lift. A single control lever provides forward and reverse turning for a fork-lift truck, made by Automatic Transportation Company Division of Yale & Towne, Chicago, Ill., that will travel in any direction, at any angle. Bulky odd-shaped loads can be carried across the forks and moved sideways down narrow aisles. Steering wheel provides angle and side steering.

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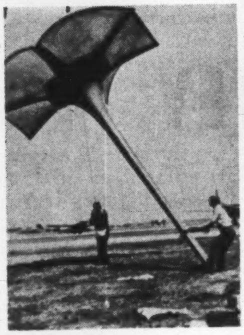

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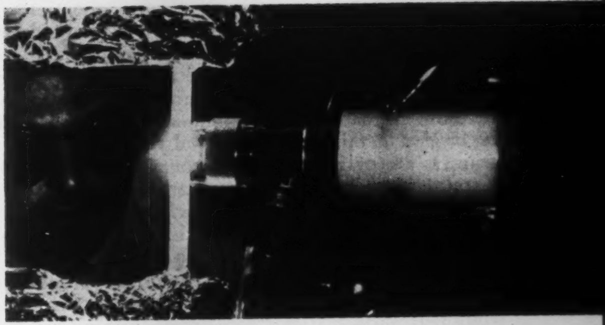

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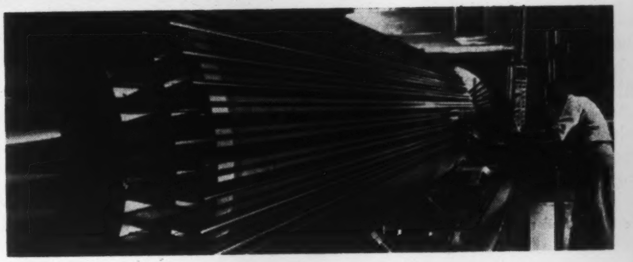

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Engineering
Progress in the
British Isles and
Western Europe

J. FOSTER PETREE
European
Correspondent

EUROPEAN SURVEY

Water Purification Plant—London

The Metropolitan Water Board, who are responsible for the water supply of London, England, have recently brought into service a new purification plant with a capacity of 90 million Imperial gal per day. Most of London's water is taken from the river Thames above Teddington Weir, which is the upstream limit of tidal flow. The new filter station is at Ashford Common, about six miles as the crow flies above Teddington and about 17 miles west-south-west of the City center. The site occupies 125 acres of land adjoining the large Queen Mary Reservoir, from which the water is drawn through a tunnel 100 in. in diam or from an existing 72-in. conduit which passes near the site and, after purification, can be pumped to districts to the north, west, or south of London as required.

The purification process consists of aeration, microstraining, slow sand filtration and chemical treatment. The incoming water is automatically controlled by two 54-in. valves and is discharged into two aeration basins, each 90 ft in diam, in a hollow cone, the velocity of discharge being kept constant at all rates of flow. In these basins the water is fully oxygenated and any odors resulting from stagnation in the reservoir are dispersed. The water then passes to the microstrainers, of which there are 24, each 10 ft in diam and 10 ft long; this is the largest installation of its kind yet constructed. The strainers are cylindrical cages covered with a fine mesh of stainless-steel wire, having nearly 80,000 apertures per sq in. The water enters the cylinder at one end and passes outward through the mesh, the cylinder rotating continually about its axis, which is horizontal. Water jets play on the mesh along the top of the cylinder, washing the algae and other foreign matter into an internal trough, from which it drains away through the hollow shaft.

From the microstrainers the water passes to the slow sand filter beds, of which there are 32, each $^3/_4$ acre in area. In these a 2-ft thickness of sand covers a 3-in. thickness of fine gravel resting on a drainage system of porous concrete formed of channels 6 in. wide and 4 in. deep, spaced $9^1/_2$ in. apart. The water filters through at the rate of 4 gal per sq ft per hr. When they become choked the beds are mechanically cleaned, two methods being available. One is by a hydraulic sand-washing machine carried on a traveling gantry spanning the bed, which does not have to be emptied for cleaning. The other method is by a traveling sand-handling bridge

Water Purification Plant, London. **1** Three gas-turbine generating sets. **2** Pump house of water purification plant, low lift pumps, in foreground, deliver raw water from Queen Mary Reservoir. **3** Diesel-driven alternator sets in noise-reducing glass booths. **4** Microstrainers of stainless steel wire mesh have nearly 80,000 apertures per sq in.

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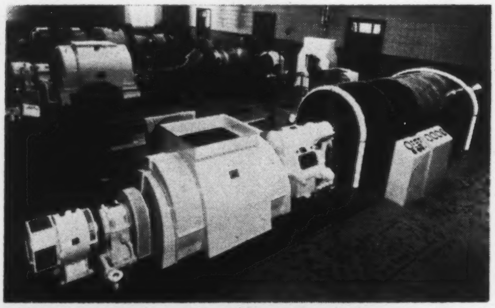

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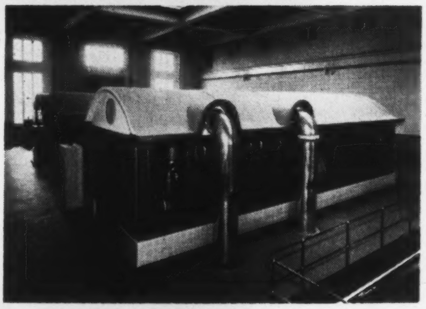

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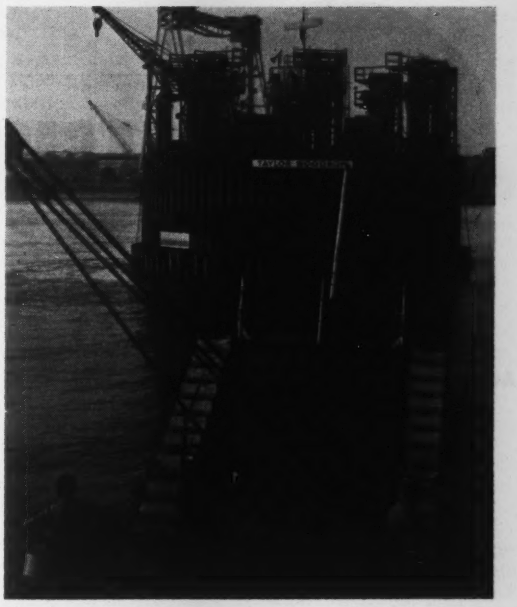
and is used with the bed empty, the old sand being removed and new sand deposited. After filtering, the water is superchlorinated up to a maximum dose of $2^1/_2$ parts per million. The chlorine is injected before the water enters the contact tank, in which it remains for one minute. Equipment is also provided for injecting sulfur dioxide or ammonia, to regulate the amount of chlorine going into the supply. As the contact tanks are above filter level, the water must be pumped into them; this is done by eight pumping units housed in two small pumphouses. The total pumping capacity is 180 million gal per day—twice the designed throughput of the station.

The main pumping station contains eleven inclined-spindle low-lift pumps for the unfiltered water and twelve vertical-spindle high-lift pumps for delivering the purified water to supply. There are also three small high-lift pumps delivering to the local supply area. The low-lift pumps have a combined capacity of 300 million gal per day and a maximum water hp of 1927. Normally the pumps take their electric current from the public supply, but, so that the plant shall be independent of this if need be, it has also its own generating equipment, which can maintain the full output if the public supply fails. This standby generating capacity is provided by three 16-cyl General Motors two-stroke oil engines, each driving an 1100-kw alternator and delivering current at 3300 v. These engines were bought from the British Admiralty, to obtain quick delivery. They were found to be unduly noisy and so each has been enclosed in a sound-reducing casing with double glass windows, which reduces the sound level in the engine room from 101 db to 75 db. The air supply to the engines is taken from outside the building at roof level.

There are also three alternators driven by gas turbines—a new departure for the Board and, it is believed, in waterworks practice generally. They have been supplied by three different manufacturers—the Metropolitan-Vickers Electrical Company, the English Electric Company, and the Brush Electrical Engineering Company—so that experience with different types may be obtained, with a view to future developments. The English Electric set has a capacity of 2250 kw and the other two are 2500-kw sets.

Machine-Tool Exhibition

The remarkable new shell-roof exhibition hall at the Rond-Point de la Défense, Paris, which was described and illustrated in the "European Survey" for February, 1959, will be the venue of the 6th European Machine Tool Exhibition, which opens on September 12 and will continue through September 21. It is being organized by the Syndicat des Constructeurs Francais de Machines-Outil, whose address is 150 Boulevard Bineau, Neuilly-sur-Seine (Seine), France. More than 3500 machine tools, many of them in operation, will be shown by nearly 1000 exhibitors from nine countries. As has happened on other occasions, the German exhibitors will be the most numerous, 330 of them having booked space. France comes next, with 315. The other countries to be represented are Austria (12 firms), Belgium (25), Great Britain (64), Italy (90), the Netherlands (10), Sweden (20), and Switzerland (97). A point worth noting is that no charge for admission will be made in the case of visitors from countries outside of France, who will need only to show their passports.



Man-made concrete island launched in Bristol Channel, England, view from the tug "Plantaganet." Island acts as cooling-water-intake structure for Hinkley Point atomic power station.

Concrete Island in the Bristol Channel

For the 500-mw atomic power station under construction at Hinkley Point, on the southern shore of the Bristol Channel, England, for the Central Electricity Generating Board, it was necessary to provide a cooling-water intake from the Channel, capable of passing 35 million gal an hr. As there is a tidal range of 35 ft and shoal water inshore, this meant that the intake must be located well out in the Channel.

The problem was solved by constructing a concrete caisson in the form of a cylinder 90 ft diam, 60 ft high and weighing 3900 tons and floating it out to the required position, 2000 ft distant from the sea wall of the power station. It was constructed in an excavated "dock" on the foreshore, behind a steel-piled cofferdam which was removed when the caisson was ready for floating. The operation of launching it, towing it into position, and setting it on the bottom, supported by eight "spuds," had to be carried out quickly though with extreme precision, as the maximum time available was only four hr. It was winched out through a narrow channel dredged in the rocky foreshore, taken by a tug into deep water, located in position by cross bearings, and secured to prepared moorings as the tide began to fall.

As the water level dropped and the legs made contact with the bottom, their length was hydraulically adjusted to keep the caisson on an even keel. When it had been lowered to the designed ground penetration, flooding valves were opened to prevent it from lifting as the tide returned. The whole operation took eight hr.

Contractors for this tricky operation were the Taylor Woodrow Construction Company, an associated company of the English Electric—Babcock & Wilcox—Taylor Woodrow atomic power group who are building the Hinkley Point station.

Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Aviation

The Shock Wave Noise Problem of Supersonic Aircraft..59—SA-51...By H. H. Hubbard and D. J. Maglieri, NASA, Langley Research Center, Langley Field, Va. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Shock waves generated by aircraft in supersonic flight may result in objectionable noise disturbances at ground level. These noises, which are explosive in character, are now normally called "sonic booms." At present, because of performance limitations, there is no sonic-boom problem for commercial aircraft.

With regard to future supersonic transport operations, however, the sonic boom may be one of the most serious noise problems encountered. This particular problem is of concern because it may have a far-reaching influence on both the design and the operation of supersonic transport aircraft. The objectives of this paper are, first, to describe the nature of the sonic boom and some of its effects, and then to indicate the manner in which it may affect design and operations.

It has been noted that the ground-noise pressures associated with the shock waves of supersonic aircraft may be objectionable to people on the ground and, in the extreme cases, may cause physical damage to light structures. For supersonic transport operations, large areas will be exposed to these shock-wave noise pressures. It is estimated that these pressures will be tolerable for the high-altitude part of the flight but may present some serious problems during the lower-altitude climb and descent phases. It is therefore important that both the designer and the operator of supersonic transport airplanes recognize the potential seriousness of this problem and provide for means to minimize it.

Staged Supersonic Transports . . . The Small Airplane Returns...59—SA-31.. By Walter Daskin, Assoc. Mem. ASME, Lewis Feldman, and E. A. Sanlorenzo, General Applied Science Laboratories, Inc., West Hempstead, N. Y. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Inefficiencies of operating conventional aircraft which carry, for the entire flight, the large engines required for acceleration, the fuel tanks which have been emptied during the acceleration, and the attendant structure are pointed out.

A study is described which investigates whether separation of the acceleration and cruise phases of the flight by using two aircraft would be more efficient than performing the flight with one airplane.

The mission investigated was that of transporting 60 passengers a still-air range of 3500 n miles at a cruise of Mach 4.

The study has shown that, even for moderate ranges, the two-stage airplane would be more efficient than the corresponding single-stage aircraft, particularly when operating over routes with moderately small traffic density. The resulting flexibility and economy of operation are expected to outweigh the disadvantages of extra crew and air-traffic control problems.

Technical and Economic Factors of Supersonic Transport..59—SA-40...By F. A. Payne, North American Aviation, Inc., Inglewood, Calif. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Supersonic transportation is feasible, desirable, and possibly even inevitable within the foreseeable future.

It appears that the most likely candidate for the supersonic transport will be designed to carry between 100 and 200 passengers across transoceanic and transcontinental distances at a speed of Mach 3.

This vehicle will weigh upward of 300,000 lb and will operate at costs competitive with current jet transports.

Technical factors having a major effect on design and operations of such a craft are discussed briefly. Choice of speed, range-cost relationships, cost-capacity relationships, design features, environmental control, air-traffic control, and the problem of noise are treated.

Designing Tomorrow's Commercial Supersonic Transport Engine..59—SA-32... By G. C. Rapp, General Electric Company, Cincinnati, Ohio. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960)

Rapid movement of the supersonic transport to the forefront of commercial transport consideration is an indication of the technical progress in the aircraft industry. Technical progress in the industry has been made in at least three principal areas that are pertinent to supersonic transport; namely, (*a*) aerodynamic design, (*b*) aircraft structure and equipment, and (*c*) power plants.

Aerodynamic designers have contributed a significant increase in the aircraft L/D which is possible in the speed range between Mach 2 and Mach 3.

Developments in aircraft structures and equipment have solved many of the problems associated with design and fabrication of lightweight temperature-resistant aluminum structure for the Mach 2 regime of operation and steel structure for the Mach 3.

Power plants are operating at Mach 2 in military aircraft on a daily basis. Development of a satisfactory power plant for Mach 3 transports has already begun. As the result of advances of the technical state of the art, these engines will have substantially improved efficiencies. Engine development must be closely integrated with design of the airframe to result in the most efficient high Mach system because of the increased complexities involved in their interrelations at high-flight speeds.

In setting forth the design of a supersonic transport engine, there are three main areas of consideration: Performance, reliability, and maintainability. Each of these areas is discussed briefly to indicate some of the pertinent factors in the design of a supersonic aircraft. The problems of both the engine and airframe manufacturers are considered in a qualitative manner, and the co-operation necessary for their satisfactory solution is indicated.

Rocket Power for Manned Flight..59—SA-65...By J. M. Cumming, Rocketdyne, A Division of North American Aviation, Inc., Canoga Park, Calif. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Rocket power for aircraft propulsion has been under serious consideration and limited use for some time. Present application in transport aircraft is limited to thrust augmentation at take-off. For this purpose, solid-propellant JATO units are used which provide approximately 1000 lb of thrust for 15 sec each. In this country, only the military has used liquid-propellant aircraft rocket engines to provide superperformance for air-breathing aircraft.

Design and development of a series of rocket engines for use with jet engines in military aircraft are described. General information is presented on the application of these engines to aircraft. Use of a rocket engine in combination with an air-breathing system for propulsion of commercial aircraft over distances of 2000 miles or more is described.

The Importance of Qualitative Factors in VTOL Transport Selection..59—SA-64...By L. R. Novak, McDonnell Aircraft Corporation, Lambert-St. Louis Municipal Airport, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Some measure of the importance of qualitative factors, as opposed to purely quantitative factors, in the operational suitability and selection of a VTOL transport is given. The VTOL transport aircraft are divided into two categories: Helicopter-base types developed from rotary wings, and airplane-base types developed from fixed wings.

The analyses include factors of predictability, safety, reliability, controllability, environmental suitability, performance, and economy. Purely qualitative factors are discussed in light of their effect on the ultimate employment of such aircraft. When possible, numerical equivalents of these elements are shown in terms of performance and weight.

In weighing the relative merits of the VTOL aircraft categories, it is concluded that qualitative factors are of prime importance in the selection of the VTOL transport aircraft for future procurement. Predictability of performance, cost, and operational compatibility should be strong considerations in any selection.

It is believed that the higher degree of predictability at the present time rests with the helicopter-base type since acceptable airplane cruise as well as acceptable vertical take-off and landing qualities have already been achieved. If typical operating altitudes of VTOL transports are limited to 10,000 ft or less, the airplane-base type loses its speed advantage over the helicopter-base type because of economic reasons. If a single type can be selected to satisfy the over-all mission spectrum, the procurement of this one type in place of several specialized types can result in making available more than twice as many VTOL transports for the same over-all cost. Furthermore, it would promote commercial expansion and provide the nation with the greatest emergency potential at lowest cost. The impact of such a conclusion is so great that it should justify an all-out effort to fully evaluate the VTOL concepts, taking full consideration of the qualitative factors as well as the quantitative factors on a merit and demerit basis.

Some Conclusions on VTOL Flight Characteristics and Future Developments Based on XV-3 Convertiplane Tests..59—SA-59..By C. E. Leibensberger, Bell Helicopter Corporation, Fort Worth, Texas. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

The Bell XV-3 Convertiplane is a fixed-wing, tilting rotor-prop VTOL research-type aircraft designed to combine the vertical flight capabilities of the helicopter with the speed and range performance of the airplane.

Upon successful completion of various preflight development tests which proved the reliability and structural integrity of the aircraft and its systems, full-scale wind-tunnel tests, in conjunction with a direct analog-computer study, resulted in the development of a completely stable rotor configuration throughout the flight envelope.

Extensive aerodynamic performance and stability data were obtained at various conversion angles between helicopter and airplane configurations, and in high and low-gear ratios throughout the flight-speed range.

Flight testing results from hovering throughout the forward flight and full conversion regime showed acceptable hovering and satisfactory forward flight control and stability characteristics. Future designs are briefly discussed.

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Management

Computers in Research and Engineering..59—SA-55...By Leon Cooper, Monsanto Chemical Company, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

At the present time, computers of all kinds have found widespread use throughout the United States. There are several thousand digital and analog computers installed and in use in various segments of industry, government, and academic institutions. It seems clear that the use of computers is on a firm foundation and that their influence in our society and on our lives is increasing as time progresses.

Computer applications in the chemical and petroleum industries include:

1 Many aspects of research and development such as kinetic and thermodynamic calculations pertaining to new processes and products.

2 Engineering studies pertaining to design, operation, and control of existing or new plants.

3 Data processing including general accounting, inventory control, and sales analyses.

4 Operations-research studies such as production, inventory and sales control studies, marketing research studies, and allocation of products by linear programming techniques, and other economic analyses.

5 In the petroleum industry such important areas as exploration and production of crude oil and gas.

6 Information retrieval problems such as retrieval of business and economic data, storing and searching of special files of material such as chemical compound data.

A detailed treatment of computer applications at the Monsanto Chemical Company is presented in this paper. Computer solutions have been employed in the following areas: Chemical research, engineering research, engineering design and operation, operations research and operations studies, routine processing of data, information retrieval and report writing, economic and market studies.

Research and Engineering Management and Controls..59—SA-45...By S. R. Irish, Winchester-Western Division, Olin-Mathieson Chemical Corporation, East Alton, Ill. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

It is shown that research and engineering projects are susceptible to control techniques. After defining terms for common understanding of the discussion, the need for clear assignments is demonstrated not only for good management but also for the use of controls. The important characteristics of controls and their application are outlined with an actual example illustrating how the use of controls aids in the successful completion of complex research and engineering projects and represents one of the valuable tools of the manager.

The art of managing cannot be performed satisfactorily unless the leader has the understanding of the technical and scientific aspects of the problems constantly coming to him for solutions. He likewise must have the confidence of his subordinates that he is dedicated to the interests of the whole and will deal fairly and justly in all things. The use of controls, as developed for the measurement of specific or general tasks and assignments, can be a tremendous help in accomplishing this delicate balance and in satisfying the objectives of top management.

Integrated Cost Reduction..59—SA-43... By C. W. Nedderman, Edward Valves, Inc., subsidiary of Rockwell Manufacturing Company, East Chicago, Ind. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Integrated cost reduction may be defined as cost reduction through integrating human behavior with environment—integrating cost-reduction programs with the everyday actions of the people in the company. People must know what to do and why they are to do it before they can do anything effectively. Therefore management must develop a system of communications which will impress all employees with the importance of cost reduction at every level.

This paper describes a system of communications—messages that constitute meaningful motivation for cost reduction—as it is used in one company. The firm makes use of bulletins, organization manuals, training programs, intraplant committees, and conversation in an effort to integrate its program.

Through these channels they have established a spirit of competition, confidence in leadership, knowledge of competition, soundness of strategy, and meaningful motivation.

Expressing Business Opportunities in Terms of Product Requirements..59—SA-44... By D. E. Chambers, General Electric Company, Schenectady, N. Y. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

In the contributions he can make to the formulation of requirements to be met by his company's products and services, the product engineer today has increasingly important responsibilities for influencing strategy.

While some of the product engineer's contributions may be fairly obvious, it also may be that it is precisely this that obscures the possibilities with respect to further contributions which he can, and should, make—and which will be of equal, if not greater, importance.

Experience suggests that it is easy to take the relatively short view of what is involved—a view which, when adopted by the production engineers, leads into the following pitfalls:

1 Preoccupation with the design problems involved in exploiting present products.

2 Exclusive concentration on the qualities of the products.

3 Design "optimization" which overlooks or ignores important manufacturing and marketing-cost elements inherent in design.

4 Failure to seek out and take advantage of opportunities to provide for doing research and engineering work in advance of immediate customer or market need, or especially in the diversified company, on a pooled basis.

The author outlines four challenges which will permit the avoidance of these pitfalls. These are the challenges to innovate, formulate, integrate, and to anticipate.

The Budget Nobody Talks About..59—SA-42... By A. R. Adler, Assoc. Mem. ASME, General Electric Company, Cincinnati, Ohio. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

In considering budgets for a manufacturing enterprise, the problem of in-warranty or complaint expenses is not often given as much attention as it requires. It is not unusual, in certain types of businesses, for this expense to be as high as five per cent of sales. For this reason it is necessary to develop an in-warranty expense budget for normal conditions and failure rates.

Management must realize that insufficient reserves for in-warranty expenses will change the entire profit picture of the company and tend to shift the break-even point. Profits for the budgeted sales volume will therefore be reduced or even wiped out. On the other hand, excessive reserves may result in a noncompetitive pricing structure. It is therefore mandatory for any company having substantial in-warranty expenses to budget and forecast these expenses if it hopes to remain in business.

Engineering for Profit..59—SA-41... By H. J. Richmond, A. T. Kearney and Company, Chicago, Ill. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

A program to achieve maximum contribution to profits from engineering activities has many phases and takes time, planning, and patience to accomplish. Product and production engineering personnel will welcome this sensible approach; they will enjoy engineering for profit as a way of life.

The major points to be considered are as follows:

1 Integration of engineering with the company organization.

2 Standardization of products, parts, materials, specifications, and tolerances.

3 Control of changes to products, parts, and materials.

4 Control of records.

5 Control of research, development, and design costs.

6 Control of product and production release costs in purchasing and manufacturing phases.

The growth companies of tomorrow in their respective industries are those which are developing their personnel along with the new products or major improvements in existing products!

They are proceeding on a planned, consistent basis; they will not be panicked into snap decisions and erratic actions. They are developing employee attitudes which insure receptivity to changes and willingness to plan and program the detailed steps of product research development, design, manufacturing, and marketing. They are emphasizing the need for profits and for the reduction of costs. They know that costs must be controlled at their source; engineering design is one of the key originating sources. Preventive steps pay off!

Creative Thinking—An Engineering Method..59—SA-26... By D. L. Purdy, Assoc. Mem. ASME, General Electric Company, Cincinnati, Ohio. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

One of the most fascinating and yet one of the least understood processes used by man to conquer nature is the process of unique thought. Although science and technology are advancing at an astounding rate, the foundation of thought upon which they are built remains a comparative mystery. This is due to many factors, such as the inherent complexity of the process itself, the division of professions into categories such as psychology, engineering, or medicine, the absorption of professional people in the more tangible and practical pursuits, and the great success that the seemingly pure analytical approach has had in today's expanding technology.

This paper describes creative thinking in engineering work by: Describing the brain mechanism; investigating the memory process; comparing the brain with a known memory circuit; describing analytical thought as related to brain functioning—and concept formation; describing the traits of creative individuals; and hypothesizing a mechanism for creative thought based on individual traits and facts concerning brain functioning.

The paper then suggests ways in which this hypothesis may be applied to improve and stimulate creative thinking.

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Rubber and Plastics

Field Testing of Tires Made With Tyrex Viscose Tire Cord..59—SA-52... By F. B. Breazeale, American Enka Corporation, Enka, N. C. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

A new viscose tire yarn, Tyrex, has improved strength both dry and wet, absence of growth or creep, retention of properties under high-temperature conditions, and ability to take the strain-compression cycling to which tire cords are subjected in use.

Over the years, satisfactory laboratory tests have been devised in the tire-fabric industry to determine all these properties. However, the last one, fatigue, remains an enigma, since tire cord in a tire is part of a three-component system—fiber, dip or adhesive, and rubber stock—all of different strain and compression moduli, and the actions and interactions of these in an operating tire are still not resolved. Nevertheless, in all the various laboratory tests devised to measure the ability of a cord to withstand this fatiguing cycle, Tyrex viscose tire cord proved vastly superior to the then standard rayon tire cords.

Indoor tire tests were conducted on tires made with Tyrex viscose tire cord. These tests simulate, under controlled conditions, some of the more extreme trials to which tires are put in service, such as high speed, prolonged subjection to bruising either from a plunger spike or metal cleats, long running under overload, underinflation conditions, and so on.

After the exceedingly satisfactory showing of tires reinforced with viscose cord in indoor trials it was decided to organize four major tests, using this material, covering the most important features of tire performance—high speed; taxi fleet operation to determine treadwear and durability; truck tire testing; and finally, impact testing under rough secondary road conditions.

Details of these tests and results obtained are described in this paper.

Preparation and Processing of Nylon Tire Cord..59—SA-50... By J. W. Bolmeyer, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Nylon cord is used as a reinforcing structure in tires, similar to the manner in which steel is used to reinforce concrete. The engineer usually thinks of a reinforced structure as one that is rigid. A tire, of course, is not a truly rigid structure; and consequently the nylon cord in its role as a reinforcing material will be flexed, extended, and compressed millions of times during the life of a tire. Nylon is outstanding in its ability to take this type of punishment and is therefore well suited for its role as a tire-reinforcing agent.

The basic chemistry of nylon, the steps used in the manufacture of nylon yarn, and the preparation of nylon tire cord are reviewed.

Tire Testing..59—SA-48... By J. W. Hannell, Assoc. Mem. ASME, E. I. du Pont de Nemours and Company, Inc., Newport, Del. 1959 ASME Semi-Annual Meeting paper (multilithographed; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1960)

Widespread adoption of nylon as a tire-cord fiber and the substantial improvements made in the properties and performance of both nylon and rayon tire yarns during the past 10 years are a direct result of the intensive research and development programs carried out by the tire manufacturers and the major fiber producers. One of the factors which has made this rapid progress possible has been the increase in basic knowledge of the ways in which the physical properties of the tire yarn are related to the performance of the tire in service; this information is developed continually through the service experience and testing programs of the tire manufacturers, as well as the laboratory and tire tests carried out by the tire-yarn producers to guide their research programs.

Testing, carried out by the tire-yarn producer, has an objective somewhat different from that of the tire manufacturer. While both need an over-all evaluation of the performance of specific tires under a variety of rather rigorous conditions, the fiber producer must make a strong effort to understand what is happening to the fiber during the tests and why it performs as it does. Armed with this knowledge, he can modify the fiber so that it will do a better job. The testing of tires thus becomes primarily a method for subjecting the fiber to the kinds of stresses, strains, and temperatures it will meet in actual service, and observing the extent of damage.

The tire tests discussed have the common characteristic of providing data which measure directly and quantitatively the contribution of a given tire-cord fiber to tire performance. Examples of the use of the crown-impact-endurance test to evaluate the effects of changing cord strength, gage, and fabric end count were included. The flex test was shown to provide comparative indexes of fiber performance by the direct measurement of strength loss produced by repetitive flexing at relatively low speeds and temperatures, while the high-speed-endurance test provides a method for evaluating fibers in high-speed, high-temperature service. The truck-tire test is of value in studying the factors which control the rate of heat generation and the load-carrying capacity of tires.

Power

Sea Water Distillation With By-Product Power at Aruba..59—SA-24... By G. E. Sonderman, Mem. ASME, Singmaster and Breyer, New York, N. Y. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

In June, 1958, the Government of the Island of Aruba in the Dutch West Indies, some 15 miles off the coast of Venezuela, started operation of its new $10,600,000 salt-water conversion plant. This event was a significant milestone in the accelerated search for an inexpensive means of wresting fresh water from the sea.

The salient features of the project are:

1 Its capacity for producing 2,700,000 gal per day of potable water makes it the largest single installation yet undertaken. Aruba's meager rainfall—less than 14 in. a year—cannot provide even a secondary source of supply, and the plant is therefore the sole supply for the island's population of 55,000.

2 Aruba has no fuel of its own, and so the government must buy the fuel oil needed for distillation from the local refinery at the going commercial price. As the cost of fuel is the largest single factor in the cost of distilled water, a highly efficient installation was essential. In contrast, the large distilling plants at Kuwait are supplied with very cheap fuel and cannot be considered representative.

3 Aruba also needed more electric power. Costs were rising and capacity was inadequate at the existing power plant, which had diesel-driven generators. It was an ideal opportunity to install a steam-electric plant which would exhaust its steam to the water-distillation plant. In effect, electricity is produced as a by-product of the water plant at a cost of less than 3 mills per kwhr.

4 When the profit from sale of the available electric power at normal wholesale rates is applied to the cost of water, it is quite possible that the cost of distilled water at the plant could drop to about $1.25 per 1000 gal, instead of the $2 to $3 previously considered normal cost for distilled water.

5 Lastly, the creation of an adequate supply of good water and of moderately priced electricity is a major factor in the future development of this arid land. It has already sparked the construction of elaborate tourist facilities and of a hydroponics or soilless farm which produces fresh fruit and vegetables that formerly had to be imported. Water is being sold to the vast Lago Oil & Transport Company refinery. More water and power are available to attract other industry to the island. This is a real demonstration of what the production of fresh water from the sea can do for arid lands.

This paper describes the engineering and economic features of the world's largest single installation to supply fresh water from the sea.

The plant is the first to generate inexpensive power as a by-product of the distillation process. The opportunities for the power industry to explore and develop the combined water-electricity type distillation plant are discussed.

The Thermionic Converter..59—SA-23... By V. C. Wilson, General Electric Laboratory, Schenectady, N. Y. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Recently, needs for lightweight, portable, quiet power supplies; interest in utilizing solar energy; the desire to obtain more electrical energy from atomic reactors; and the need for lightweight electric generators for space vehicles have increased the effort to develop a means of generating electricity without utilizing rotating machinery. This paper describes a family of heat-to-electricity converters which utilize the thermionic emission from a conducting surface for the source of electric charge.

In its simplest form a thermionic converter is a vacuum or gas-filled device with a hot cathode to emit electrons, a cold anode to collect the electrons, a suitable vacuum envelope, and two electrical leads. Means must be provided to heat the cathode and cool the anode. One can visualize the operation of the thermionic converter by considering it as a special kind of vacuum-tube diode.

Calculations have been made to determine the optimum conditions to obtain maximum power outputs and maximum efficiencies. Theoretical and experimental results for the closely spaced vacuum converter and for two methods of operating the gas-filled converters are given. Some possible applications are discussed.

Cooling Tower Fan Performance..59—SA-17... By G. W. Forman, Mem. ASME, University of Kansas, Lawrence, Kan.; and N. W. Kelly, J. F. Pritchard & Company of California, Kansas City, Mo. 1959 ASME Semi-Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to April 1, 1960).

The mechanical draft cooling tower has become an important equipment component in chemical plants, petroleum refineries, electric power plants, and large air-conditioning installations. Lack of natural water in adequate quantities for cooling purposes often dictates the use of evaporative water cooling in order that available water may be recirculated within the plant.

Numerous publications have dealt with the thermal performance of cooling towers, but little has been presented concerning the performance of the large axial-flow fans which have come into common cooling tower use. Misconceptions exist concerning the effects of differences in fan diameter, number of blades, blade shape, fan rpm, the design of air discharge cylinders, stacks, and so forth. This paper is presented to clarify some of these misconceptions and to show a method of predicting the performance of cooling tower fans which requires a minimum of dimensional and descriptive data.

Some Design Features of the Meramec Twin Furnace Reheat Steam Generator..59—SA-63... By M. F. Dallen, Jr., Assoc. Mem. ASME, and D. B. Stewart, Mem. ASME, Foster Wheeler Corporation, New York, N. Y. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

The steam generator for Union Electric Company's Meramec Unit No. 3 has a rated capacity of 1,850,000 lb of steam per hr with 1010 F and 2150 psig at the superheater outlet and with a reheat flow of 1,685,000 lb of steam per hr. The reheater outlet conditions are 1010 F and 529 psig. The primary fuel is pulverized West Kentucky coal with natural gas as a secondary fuel.

This is a twin-furnace boiler of the natural-circulation type employing the dual-circulation principle. It has a superheater of the combination radiant-convection type- and an all-convection reheater. Semi-outdoor construction is used with access aisle between the two furnaces for operation of soot blowers and maintenance of equipment. This center aisle and the firing front are enclosed. The outboard sides and rear of the boiler as well as air heaters, precipitators, and induced draft fans are outdoors.

The furnace liberation at rated capacity is 16,100 Btu/hr/cu ft and the heat release 78,000 Btu/hr/sq ft of projected furnace envelope. This rather liberal furnace design results in a predicted furnace outlet temperature at full load of 1940 F. The performance fuel has an ash softening temperature in a reducing atmosphere of 2290 F while typical area coals have an ash softening temperature of 2100 F.

The two furnaces are identical in construction. Each furnace contains a primary radiant superheater located in the front wall, roof, and in sections of each side wall adjacent to the front wall. The remaining sections of the side walls, the rear wall, and the full division wall are water cooled. Each furnace is followed by a convection pass in one of which is located all the reheater surface, while the other contains the convection portion of superheater surface. Each convection pass includes an economizer and a regenerative air heater.

This paper describes the general design of the steam generator for Union Electric Company's Meramec Unit No. 3, and reviews the principal features of this design.

Steam Flow Distribution at the Exhaust of Large Steam Turbines..59—SA-62... By J. E. Fowler and R. E. Brandon, General Electric Company, Schenectady, N. Y. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

One factor of significance in the design of condensers and condenser connection pieces for use in conjunction with large steam turbines is the distribution of the steam flow at the turbine exhaust flange. A knowledge of this flow distribution should assist the condenser designer in obtaining optimum condenser performance and the power plant designer in locating internal struts and piping to minimize losses.

In the case of steam turbines with large mass flow per unit exhaust flange area, the aerodynamic forces on condenser tubes may become important, along with erosion problems arising from the presence of fast-moving water droplets in the steam.

The Company with which the authors are associated has conducted some investigations of the flow distribution at the exhaust connections of typical large steam turbines. The results of these investigations on downward-discharge exhaust hoods are reported in this paper.

Influence Coefficients for Open-Crown Hemispheres..59—SA-4...By G. D. Galletly, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif. 1959 ASME Semi-Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Power; available to April 1, 1960).

Stresses and deflections of hemispherical shells with nozzle openings lying on the axis of symmetry may be determined accurately and rapidly with the aid of the tables given in the paper. The tables give the influence coefficients (i.e., stresses and deflections obtained with unit applied loads) for the edge and interior points for various types of edge bending load. The radius-thickness ratios of the hemispherical shells considered varied from 15 to 250; the total central angle of the opening varied from 20 to 100 degrees.

An illustration of the utility of the coefficients is given by considering a hemisphere-cylinder intersection problem.

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Materials Handling

Flow of Bulk Granular Materials..59—SA-46...By H. J. Barre, Mansfield, Ohio. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

The distinction between free-flowing and nonfree-flowing materials is largely an arbitrary one. A completely free-flowing material would have no friction among its particles and, therefore, a zero degree angle of repose. In other words, it could not be piled. However, grains such as wheat and shelled corn do repose by virtue of friction among the individual grains. Nevertheless, they are considered to be free-flowing materials. Such grains as oats and rough rice are even less so, because of greater internal friction. Moreover, grain can quickly lose its flowability when it contains a large amount of cracked grain, foreign material, and moisture.

This discussion is concerned primarily with the nature and stability of flow of bulk granular materials in and out of storage bins, hoppers, and spouts. Information is needed for designs of economical handling systems which will insure a positive rate of flow. Therefore the knowledge of flow behavior of granular materials in relation to the physical factors affecting it is important.

Transportation Considerations in the Selection of a Bulk-Handling System..59—SA-7...N. H. Brown, Jr., United States Rubber Company, Providence, R. I. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Selection of a bulk-handling method involves consideration of a number of factors other than mere choice of in-plant handling methods and equipment. These include: Geographical relation to industrial consumer; rate relationships for alternate methods of transportation; distribution requirements; and industrial-consumer's plant requirements.

Since installation of a bulk-handling system is generally a sizable capital outlay, it is imperative that the selection be made to avoid technological or other types of obsolescence.

Collapsible bulk containers provide a satisfactory solution to this problem. Several companies are working to develop various types of metal containers that can be disassembled, folded, or nested for major cube reduction.

Five years of commercial experience with collapsible rubber containers are related in this paper.

The collapsible rubber container offers the following operating advantages to the transportation industry:

1 The carrier can use present readily available standard equipment without modification. This is true for rail, motor carrier, barge, and ship. In rail, motor carrier, and barge this equipment is the lowest cost equipment in their respective fleets—open gondolas, open-top trucks, or open-hopper barges.

2 The collapsible rubber container upgrades the per-ton-mile earning capacity of this standard equipment. Most of this open equipment regularly handles low-grade commodities.

3 The collapsible rubber container provides a 90 per cent potential utilization factor versus a 50 per cent potential utilization for the rail bulk hopper car, a 94 per cent potential versus a 50 per cent potential to the motor carrier, and a 100 per cent versus a 50 per cent potential to the barge industry.

Containerization in Bulk Material Handling..59—SA-6...By F. J. White, Jr., Tote Systems, Inc., Beatrice, Neb. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

One of the fastest-growing techniques in bulk material handling is the use of portable unit containers. Containers can be fabricated by various materials and their capacities will normally vary from 3000 to 10,000 lb. Their greatest use is in the bulk handling of dry materials such as flour, sugar, salt, milk powders, coffee, plastic resins, and all types of chemicals.

Discussion in this paper concerns itself with the "Tote" system. The heart of the Tote system is the "tote bin." The bin is fabricated from either aluminum, steel, magnesium, or stainless steel. In nearly all cases the tote bins have a base dimension of 42 in. × 48 in. Capacity of the bin is varied by changing the height of the sidewall sheet. Heights of bins in service vary from 5 ft 9 in. to 8 ft 3 in.

Operation of the system—filling bins, shipping, storage and discharge, and batch weighing—is described in some detail and specific examples of its application are given.

It is shown that the containers, along with the accessory equipment for filling, transporting, and discharging are adaptable for interplant shipments or for solving in-plant handling problems. The efficiency in handling is comparable to large, fixed bulk storage, and they have the advantage in most cases of lower cost, simplification of conveying equipment, flexibility, and better product protection.

Dust-Tight Screw-Conveyer Design..59—SA-5...By A. L. Lyons, Monsanto Chemical Company, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

The screw conveyer is one of the oldest, simplest, most economical, and versatile methods of conveying bulk material. Unfortunately, screw-conveyer catalogs are usually composed of individual components with limited methods or basis for selection. Since screw conveyers are widely used in the chemical industry, the development of a Monsanto standard design was considered necessary.

This paper discusses some of the major features of the new Monsanto standard design for dust-tight, carbon-steel screw conveyers (6 to 18-in. diam).

Past performance, experience, and engineering judgment played important roles in the selection of suitable components. The objectives of this standard are: (*a*) Long life with minimum maintenance; (*b*) economical and rugged construction; (*c*) dust-tight features; and (*d*) conformity with vendor standards where practical.

Engineering New Breweries for Palletized Handling..59—MH-3...By G. E. Waldron, Carling Brewing Company, Cleveland, Ohio. 1959 ASME-AMHS Materials Handling Conference paper (multilithographed; available to April 1, 1960).

Not too many years ago, when a case of beer had to be moved, it was lifted by hand. Today, generally speaking, a brewery employing enough pairs of hands to lift one half of its daily output would go out of business, for current wages have priced manual labor beyond the reach of industry. In this paper, the author describes the steps taken by the brewing companies to overcome this costly situation in materials handling and speculates on future developments which may change the picture completely.

In planning a materials-handling setup and warehouse layout for a brewery, a thorough study of the particular brewery as well as a complete knowledge of the available equipment is necessary.

Prime consideration inside the warehouse is maneuverability. The allocation of space—25–30 per cent of which is aisles—to full and empty case storage is yet another consideration.

The question of palletizing and the stacking of pallets is discussed as it relates to the type of case, construction of pallets, and such.

Stock rotation is a complex factor in the operation of any brewery warehouse, since it is essential that merchandise is kept in a warehouse no longer than is absolutely necessary.

Palletizing equipment, fiber cases, depalletizing bulk handling, and other means of handling are also discussed as they relate to the specific problems of brewery operations.

Mechanized Freight Handling at Railroad Terminals..59—MH-2...By M. A. Michel, Pittsburgh and Lake Erie Railroad Company, Pittsburgh, Pa. 1959 ASME-AMHS Materials Handling Conference paper (multilithographed; available to April 1, 1960).

Three phases of railroad terminal mechanized freight handling are discussed in this paper.

Movement of export and import freight between railheads and steamship piers in the Port of New York is treated. Marine service facilities in the port are described as are general handling systems for export grain, domestic cement, movement of boxcars to ship's piers by carfloat, heavy equipment, and sea-train operation.

Improved handling of less than car load freight is considered and an example of efficient handling system in operation at The New York Central's 33rd Street warehouse in New York is given.

The handling of newsprint at a Pittsburgh warehouse is also treated in some detail.

Coal-Handling Facilities at a Power Generating Station..59—MH-1...By J. Moskowitz, Philadelphia Electric Company, Philadelphia, Pa. 1959 ASME-AMHS Materials Handling Conference paper (multilithographed; available to April 1, 1960).

One of the world's most efficient electric generating plants is nearing completion at Eddystone, Pa., on the Philadelphia Electric Company system. The plant consists basically of two 325,000-kw, cross-compound turbine generator units each with its own supercritical boiler and all associated mechanical and electrical auxiliary and supporting systems.

Facilities which have been provided for supplying the boilers with 5000 tons of coal daily are described in this paper.

Final layout and orientation of the coal-handling facilities were governed by the following considerations: (*a*) That a coal storage pile of 300,000 tons, 60-days burn, be provided on the property; (*b*) that all coal be received by rail; (*c*) that future expansion be considered; (*d*) that studies be undertaken to evaluate the economics of a one shift per day, 5-day-week unloading period; (*e*) that the conveying system be designed to permit coal to be unloaded directly to the bunkers or to the storage pile; (*f*) that single-belt conveyers rather than a parallel arrangement be provided since oil was being considered as a back-up fuel.

All of these ground rules were adhered to in the final design except that the use of oil for a back-up fuel on the main boilers was eventually eliminated. This decision to exclude oil back-up was made after careful consideration of cost for such facilities and the high degree of reliability of coal-handling equipment as experienced on the Philadelphia Electric system.

Safety

Chemical Process Safety..59—SA-21...By G. L. Gorbell, Monsanto Chemical Company, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Measures to control and eliminate conditions which are responsible for serious and often spectacular accidents in the chemical industry are set forth in this paper.

There are many reasons for the failure of process equipment, not the least of which is human error. It is, however, essential that equipment be designed to minimize if not eliminate completely the possibility of human failure.

In order to develop such controls, every possible source of an uncontrollable reaction must be investigated. With this information supplied by the chemist, the engineer is able to design normal and emergency control mechanisms into the equipment.

Depending upon the chemistry which initiates or sustains a specific chemical reaction, the normal control factors usually will be in the nature of material feed rates, heat application, and cooling medium. Solutions to the problem of control of emergency situations where reactions go out of control must also be provided.

Measures for protection from fire and explosion are also outlined.

The team approach to the safety problem is also noted as a necessary means of maintaining the high level of safety in the chemical industry.

Applied Mechanics

Analysis of Plane Stress in Polar Co-Ordinates and With Varying Thickness..59—APM-1...By H. D. Conway, Ohio State University, Columbus, Ohio. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to April 1, 1960).

The biharmonic stress-function equation for plane stress in polar co-ordinates is generalized by assuming that the thickness varies with the radius. In order to make this equation tractable, the thickness is assumed to be proportional to an arbitrary power of the radius.

Michell's general solution for the constant-thickness case is then generalized for this variation of thickness. As a numerical example, the solution is given for the problem of a segmental plate bent by end couples, the constant-thickness version of this well-known problem being due to Golovin.

Analysis of a Nonlinear Mechanical System With Three Degrees of Freedom..59—APM-29...By S. A. Hovanessian, University of California, Los Angeles, Calif. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to April 1, 1960).

In recent years the methods of solution of nonlinear vibratory systems with one degree of freedom have been extended to the solution of nonlinear systems with two degrees of freedom.

For these systems, the steady-state amplitude equations can be obtained by several methods, such as perturbation and the iteration method introduced by Duffing.

In this paper, the amplitude-frequency equations for a nonlinear mechanical system with three degrees of freedom are obtained, using Duffing's method for obtaining the steady-state amplitude equations. The steady-state response curves of two nonlinear mechanical systems, each having three degrees of freedom, are given.

On the Accuracy of Some Shell Solutions..59—APM-30...By G. D. Galletly, Assoc. Mem. ASME, and J. R. M. Radok, Shell Development Company, Emeryville, Calif. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1960).

R. B. Dingle's method for finding asymptotic solutions of ordinary differential equations of a type such as occur in the bending theory of thin shells of revolution is presented in outline.

This method leads to the same results as R. E. Langer's method, recently used for problems of this kind, and permits a simple analytical and less formal interpretation of the asymptotic treatment of such equations.

A comparison is given of edge influence coefficients due to bending loads, obtained by use of these asymptotic solutions and numerical integration of the equilibrium equations, respectively.

The particular shells investigated are of the open-crown, ellipsoidal and negative-curvature toroidal types. The results indicate that the agreement between these solutions is satisfactory. In the presence of uniform pressure, the use of the membrane solutions for the determination of the particular integrals appears to lead to acceptable results in the case of ellipsoidal shells. However, in the case of toroidal shells, the membrane and the numerical solutions disagree significantly.

On Finite Bending of Pressurized Tubes..59—APM-5...By Eric Reissner, Massachusetts Institute of Technology, Cambridge, Mass. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1960).

A unified treatment is presented of two well-known problems which have until now been considered separately. The two problems are: (*a*) The linear problem of pure bending of curved tubes, and (*b*) the nonlinear problem of pure bending of straight tubes.

In both problems the effect of uniform internal pressure is included. The essential step in the present analysis is the treatment of the flattening of the cross sections of the tube by means of a theory of finite bending of circular rings.

The general results of the paper are used to obtain improved values for the stability parameters in the problem of flattening instability of originally straight tubes acted upon by end bending moments, and also to obtain results on the effect of slight original curvature of the beam axis in the problem of flattening instability.

A Theory of Oil Whip..59—APM-2...By Yukio Hori, University of Tokyo, Bunkyo-ku, Tokyo, Japan. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1960).

Oil whip was investigated theoretically and experimentally. In the paper it is shown that the inherent instability of the rotor in previous theories can be avoided by assuming zero pressure in place of negative pressure in the oil film and that the "inertia effect" in occurrences of oil whip can be understood by distinguishing small vibrations and large vibrations of the rotor.

It is also shown that oil whip of higher order and the effect of oil viscosity on amplitude of oil whip give possible causes of some peculiar phenomena.

Creep of Thick-Walled Tubes Under Internal Pressure Considering Large Strains..59—APM-6...By F. P. J. Rimrott, Assoc. Mem. ASME, The Pennsylvania State University, University Park, Pa. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1960).

Using the generally accepted assumptions of constant density, zero axial strain, and the distortion-energy law, equations are derived for the creep rates, strains, and stresses of a thick-walled, closed-end, circular, hollow cylinder under internal pressure and made of an isotropic and homogeneous material.

The strains are considered large, requiring the use of the finite-strain theory.

A known creep rate versus stress relation is then used to solve a specific problem.

Thermal Stresses in Moderately Thick Elastic Plates..59—APM-7...By B. E. Gatewood, Mem. ASME, Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1960).

The three-dimensional stresses in the plate are investigated without using the plane-stress or plane-strain assumptions, the thickness of the plate being limited so that the normal stress in the thickness direction can be taken as a polynomial in the thickness variable.

The temperature is taken as a polynomial in the thickness variable but with relatively large, though restricted, gradients with respect to the co-ordinates of the plane of the plate.

For the case of the temperature constant in thickness variable, the stresses in the plane of the plate are presented as the plane-stress solution plus correcting terms due to the plate thickness, where the correcting terms involve the product of the temperature gradient and the ratio of the plate thickness to the plate length in the direction of the temperature gradient. In many cases the corrections are small even for moderately thick plates.

The Frequency of Flexural Vibration of Rectangular Orthotropic Plates with Clamped or Supported Edges..59—APM-8...By R. F. S. Hearmon, Forest Products Research Laboratory, Princes Risborough, Aylesbury, Bucks, England. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1960).

Warburton has derived approximate expressions for the frequencies of all the modes of vibration of isotropic plates subjected to any combination of free, supported, or clamped edges. He applied the Rayleigh method, assuming that the deflections of the plates could be represented by suitable characteristic functions satisfying the boundary conditions and that the nodal lines were approximately parallel to the sides of the plates.

In the present paper, Warburton's treatment is extended to the "specially orthotropic" plate with any of its edges either clamped or supported; i.e., to a plate made of a material possessing three mutually perpendicular axes of elastic symmetry, two of which lie in the plane of the plate parallel to the respective sides. The third symmetry axis is normal to the other two and is therefore perpendicular to the plane of the plate. The thickness of the plate and its deflection are assumed small; under these conditions, a two-dimensional treatment applies, and the elastic properties in the third symmetry direction do not enter into the problem.

On Inertia Effects in a Transient Thermoelastic Problem..59—APM-9...By Eli Sternberg, Assoc. Mem. ASME, and J. G. Chakravorty, Brown University, Providence, R. I. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1960).

This paper is concerned with the dynamic treatment of a transient thermoelastic problem for a semi-infinite medium which is constrained against transverse displacements and is exposed to a uniform time-dependent heating (or cooling) of its entire plane boundary. The stress distribution appropriate to this problem, in the event that the surface temperature is a step-function of time, was previously established by Danilovskaya and by Mura.

In the present investigation the accompanying displacements are determined in closed form. In addition, an exact closed solution, in terms of error functions, is obtained for the case in which the time-dependence of the given surface temperature is of the ramp-type. The ensuing field of thermal stress is compared with the corresponding quasi-static stress distribution, with a view toward a quantitative assessment of the accompanying inertia effects as influenced by the rate at which the temperature of the boundary is altered.

The results indicate that the conclusions reached by Danilovskaya and Mura are in need of essential modification once the assumption of an instantaneous change of the surface temperature is abandoned.

A New Theory of Elastic Sandwich Plates—One-Dimensional Case..59—APM-23...By Yi-Yuan Yu, Assoc. Mem. ASME, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. 1959 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1960).

A new flexural theory of isotropic elastic sandwich plates is deduced from the theory of elasticity. The one-dimensional case is presented in this paper. The theory includes the effects of transverse-shear deformation and rotatory inertia in both the core and faces of the sandwich, and no limitation is imposed upon the magnitudes of the ratios between the thicknesses, material densities, and elastic constants of the core and faces of the sandwich.

The method used is an extension of one due to Mindlin, and the results reduce to those of his for the corresponding homogeneous plates as special limiting cases. A final equation also may be simplified and reduced to the corresponding results of Reissner, Hoff, and Eringen for the bending of ordinary sandwich plates that have thin faces. Results of the theory are applied to the problem of bending of a cantilever plate subjected to load at the unsupported end and to the problem of propagation of straight-crested waves in an infinite plate.

Heat Transfer

The Use of Thin Films for Increasing Evaporation and Condensation Rates in Process Equipment..59—SA-30...By E. L. Lustenader, Mem. ASME, R. Richter and F. J. Neugebauer, Mem. ASME, General Electric Company, Schenectady, N. Y. 1959 ASME Semi-Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1960).

This paper describes an experimental investigation of an evaporating and condensing test apparatus in which over-all heat-transfer coefficients as high as 8000 Btu/(hr) (sq ft) (deg F) were obtained with water by utilizing thin films both in evaporation and condensation. The films were obtained by wiping, on the evaporating surface, and utilizing surface tension effects on the condensing surface. The phenomena on both the evaporating and the condensing surfaces are amenable to theory.

Numerical Solutions to an Inverse Problem of Heat Conduction for Simple Shapes..59—SA-20...By G. Stolz, Jr., Columbia University, New York, N. Y. 1959 ASME Semi-Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1960).

Numerical methods are presented for solving an inverse problem of heat conduction: Given an interior temperature versus time, find the surface heat flux versus time. The analysis is developed specifically for spheres; it applies to other simple shapes.

The system is treated as linear, permitting use of the superposition principle. The essence of the method is the numerical inversion of a suitable direct problem: Given a surface heat flux versus time, find an interior temperature versus time.

Care is required in selecting a time spacing, for if it is chosen too small in relation to the conditions, undesirable oscillation results.

Simplifying suggestions are presented, and the use of the methods is illustrated by examples.

Turbulent Flow in a Circular Tube With Arbitrary Internal Heat Sources and Wall Heat Transfer..59—SA-19...By R. Siegel, Assoc. Mem. ASME, and E. M. Sparrow, Assoc. Mem. ASME, NASA, Lewis Research Center, Cleveland, Ohio. 1959 ASME Semi-Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1960).

An analysis has been carried out to determine the heat-transfer characteristics for turbulent flow of a heat generating fluid in a circular tube with wall heat transfer. The internal heat generation is uniform over the tube cross section, but may vary longitudinally in an arbitrary manner.

The wall heat transfer may also vary in an arbitrary way in the longitudinal direction. The analysis applies along the entire length of the tube; that is, in thermal entrance as well as fully developed regions.

The fluid is assumed to have a fully developed turbulent velocity profile throughout the length of the pipe. Numerical results are presented for fluids with Prandtl numbers ranging from 0.7 to 100 for Reynolds numbers from 50,000 to 500,000. The extension of the results to include radial heat source variations is indicated.

Heating and Cooling Air and Carbon Dioxide in the Thermal Entrance Region of a Circular Duct With Large Gas to Wall Temperature Differences..59—SA-15...By Helmut Wolf, Assoc. Mem. ASME, Rocketdyne, A Division of North American Aviation, Inc., Canoga Park, Calif. 1959 ASME Semi-Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1960).

The local heat-transfer characteristics for air and carbon dioxide in the thermal entrance region have been determined experimentally and are compared with predicted values computed from an extension of the theoretical analysis due to Deissler.

The experiments were conducted in smooth round tubes having a fully developed turbulent velocity profile and a uniform temperature distribution at the entrance.

The boundary conditions of uniform heat flux for heating the gas, and wall temperature constant and variable with axial distance for cooling the gas, were investigated with large temperature differences between the gas and the tube wall. For heating, the experimental results yielded one per cent thermal entrance lengths ranging from 11 to 27 diameters over the bulk Reynolds number range from 50,000 to 246,000. For cooling, one per cent thermal entrance lengths ranging from 12 to 26 diameters were obtained for bulk Reynolds numbers ranging from 17,000 to 218,000. The agreement between theory and experiment was favorable in most cases.

Optimization of a Conventional-Fuel-Fired Thermoelectric Generator..59—SA-14...By B. W. Swanson and E. V. Somers, Westinghouse Research Laboratories, Pittsburgh, Pa. 1959 ASME Semi-Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1960).

The purpose of this report is to investigate conditions for optimizing the thermal efficiency of the design of a conventional-fuel-fired thermoelectric generator. Equations have been developed for the following:

1 The temperature distribution of the heated gas in a circular duct type of generator, that maximizes the thermoelectric power output, with respect to the temperature distribution within the duct and the exit-gas temperature at the end of the duct.

2 The thermoelectric power developed, based upon these optimizing temperature criteria.

3 The required variation of thermoelectric element thickness required to satisfy both optimizing temperature criteria.

4 Thermal efficiency under optimum conditions.

Laminar Condensation Heat Transfer on a Horizontal Cylinder. .59—SA-13. . . By E. M. Sparrow, Assoc. Mem. ASME, and J. L. Gregg, Assoc. Mem. ASME, NASA, Lewis Research Center, Cleveland, Ohio. 1959 ASME Semi-Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1960).

A boundary-layer analysis is made for laminar film condensation on a horizontal cylinder. The formulation includes both the inertia forces and energy convection terms, which are neglected in Nusselt's simple theory. A similarity transformation, valid over most of the cylinder, is found which reduces the partial differential equations of the problem (the conservation laws) to ordinary differential equations. Numerical solutions of the resulting ordinary differential equations are available for the Prandtl number range from 0.003 to 100. Heat-transfer results are presented and discussed.

ASME TRANSACTIONS

The August, 1959, issues of the Transactions of the ASME—*Journal of Heat Transfer* and *Journal of Engineering for Industry* (available at $1.50 per copy to ASME Members; $3 to nonmembers) —contain the following:

Journal of HEAT TRANSFER

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175 Heat Transfer Between Concentric Rotating Cylinders, by I. S. Bjorklund and W. M. Kays. (58—A-99)

187 Full-Scale Human-Body-Model Thermal Exchange Compared With Equational Condensation of Human Calorimetric Data, by L. P. Herrington. (58—A-181)

195 The Emissivity and Absorptivity of Parachute Fabrics, by J. P. Hartnett, E. R. G. Eckert, and R. Birkebak. (58—A-125)

202 An Experimental and Analytical Study of Vortex-Flow Temperature Separation by Superposition of Spiral and Axial Flows—Part I, by J. E. Lay. (58—SA-71)

213 An Experimental and Analytical Study of Vortex-Flow Temperature Separation by Superposition of Spiral and Axial Flows—Part II, by J. E. Lay. (58—A-90)

223 Analysis of the Aerodynamic Heating for a Re-Entrant Space Vehicle, by M. J. Brunner. (59—Av-5)

230 A Photographic Study of Boiling in the Absence of Gravity, by R. Siegel and C. Usiskin. (59—Av-37)

237 Some Radiator Design Criteria for Space Vehicles, by J. P. Callinan and W. P. Berggren. (59—Av-29)

245 Optimization of a Conventional-Fuel-Fired Thermoelectric Generator, by B. W. Swanson and E. V. Somers. (59—A-14)

Technical Briefs

249 Heat Transfer From a Rotating Disk to Fluids of Any Prandtl Number, by E. M. Sparrow and J. L Gregg

251 An Approximate Treatment of Unsteady Heat Conduction in Semi-Infinite Solids With Variable Thermal Properties, by K.-T. Yang and Albin Szewczyk

Journal of ENGINEERING FOR INDUSTRY

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187 Factors Influencing the Performance of Grinding Wheels, by E. J. Krabacher. (58—SA-40)

201 Vibrations of Flexible Precision Grinding Spindles, by R. S. Hahn. (58—A-97)

207 The Effect of Process Variables on Extrusion Pressures of Lead, by J. Frisch and E. G. Thomsen. (58—A-109)

217 Approximate Solutions to a Problem of Press Forging, by S. Kobayashi and E. G. Thomsen. (58—A-140)

228 Theory and Experiment of Press Forging Axisymmetric Parts of Aluminum and Lead, by S. Kobayashi, R. Herzog, J. T. Lapsley, Jr., and E. G. Thomsen. (58—A-154)

239 A Three-Dimensional, Tool-Life Equation—Machining Economics, by B. N. Colding. (58—A-123)

251 Some Observations on the Shearing Process in Metal Cutting, by S. Kobayashi and E. G. Thomsen. (58—A-139)

263 Observations on the Angle Relationships in Metal Cutting, by D. M. Eggleston, R. Herzog, and E. G. Thomsen. (58—A-138)

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COMMENTS ON PAPERS

Specialzed Refractories

Comment by H. E. Stidstone[1]

We comment on this paper[2] in connection with the uses of nitride-bonded silicon carbide. As manufacturers of spray nozzles, we have found that nozzles made of Carborundum Company's "Refrax AC—silicon-nitride-bonded silicon carbide have proved highly satisfactory. This is particularly true where abrasion caused by suspended particles in the fluid passing through the spray nozzle, high temperatures, and corrosion are involved. Nozzles made of this material have a longer service life and lower initial cost than the chrome-nickel stainless steels for this type of service.

Fuel Cells

Comment by D. L. Douglas[3]

The authors are to be congratulated on a fine article[4] putting the fuel cell in proper perspective as regards central-station power. Despite their relatively large specific power output—in the range of several kw per cu ft—hydrogen-oxygen cells cannot be considered for large blocks of power. This is simply because the fuel costs too much. We are in complete agreement that fuel cells for central station must be able to utilize a carbon-monoxide-containing fuel or methane without reforming to pure hydrogen. The high-temperature cell based on a molten alkali carbonate electrolyte seems the best possibility for this.

Too much emphasis cannot be placed on the importance of designing electrodes for large current density and long life. The problem was stated eloquently by William Grove in 1842, thus: "The chemical or catalytic action in the experiment detailed in that paper [the first hydrogen-oxygen cell] could only be supposed to take place with ordinary platina foil, at the line or water mark where the liquid, gas, and platina met; the chief difficulty was to obtain anything like a notable surface of action." Since that time suitable electrodes for low-temperature cells have been successfully developed. While the microporous structure involved there cannot be expected to be stable at very high temperatures, some form of porous structure is indicated for the electrodes. It is suggested that the double-porosity electrodes mentioned by the authors may get around the necessity for the magnesia matrix to retain the molten salt electrolyte. Such electrodes would be true gas-diffusion electrodes.

Regarding the fuel economics, our crude calculations of the fuel cost of producer gas or water gas from conventional gasifiers and used in a 70 per cent efficient cell are in essential agreement with the authors' results as given in Table 3. The integrated fuel cell-gasification system suggested by Dr. Gorin should produce further economies. One system on which we have not been able to obtain reliable information is the integrated underground gasification-fuel cell system. Would Dr. Gorin comment on the possibilities here?

Author's Closure

Mr. Douglas raised the question on the prospects for a fuel-cell operation integrated with underground gasification. It is the expressed belief on the part of mining engineers of Consolidation Coal Company that underground gasification cannot be regarded as a serious method of gasifying coal at the present time. The prevailing opinion is that until such time as easily mined sources of coal are exhausted that production of gas from coal would be cheaper by use of conventional underground mining followed by aboveground gasification facilities. I have however, no firm figures available to support this view.

Everett Gorin.[5]

Abrasives

Comment by L. C. Hays[6]

The authors of this paper[7] are to be congratulated on the excellent presentation and we hope the research can be continued to further explore the basic fundamentals of the grinding process.

We have confirmed the authors' comparison of the toughness numbers and grit sizes of aluminum-oxide and silicon-carbide grain. We manufacture steel and titanium jet-engine blades and abrasives of both the aluminum-oxide and silicon-carbide types are used. On coated abrasive applications we find that for roughing operations, aluminum-oxide grain is generally preferred for both steel and titanium. For finishing operations, silicon-carbide grain is often preferred. For example, we use 60-grit aluminum-oxide belts on the deburring of steel and titanium cutoff slugs, prior to forging, and we use 180-grit silicon-carbide belts to finish the leading edges of our blades.

On some titanium belt polishing operations we use silicon-carbide belts in the coarse grain sizes because of the problem of burning. Aluminum-oxide grain being tougher than silicon-carbide grain in the coarse grain sizes, tends to cap or load up with subsequent burning of the titanium, whereas silicon-carbide grain being more friable breaks down and continually presents new cutting points.

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[1] Engineer, Spray Engineering Company, Burlington, Mass.

[2] R. W. Brown, "A New Look at Specialized Refractories," MECHANICAL ENGINEERING, March, 1959, vol. 81, pp. 58–62, condensed from Paper No. 58—A-187.

[3] Research Laboratory, General Electric Company, Schenectady, N. Y.

[4] Everett Gorin and H. L. Recht, "Fuel Cells," MECHANICAL ENGINEERING, March, 1959, vol. 81, pp. 63–65, Paper No. 58—A-200.

[5] Manager, Process Research, Consolidation Coal Company, Library, Pa.

[6] Senior production engineer, Airfoil Engineering, Thompson Products, Inc., Cleveland, Ohio. Mem. ASME.

[7] G. J. Goepfert and Josephine L. Williams, "The Wear of Abrasives in Grinding," MECHANICAL ENGINEERING, April, 1959, vol. 81, pp. 69–73, ASME Paper No. 58—A-157.

Comment by C. A. Sluhan[8]

In referring to the results obtained with various fluids, which type abrasive did the authors find most effective, aluminum oxide, silicon carbide, or zirconia?

Authors' Closure

The authors' comment on the question posed by C. A. Sluhan is as follows:

The grinding-fluid data presented in Fig. 8 refer to cast-iron workpieces with intermediate Si and dC content. Wear of ZrO_2 was not obtained for this system. As Fig. 8 indicates, Al_2O_3 is more "efficient" than SiC under the conditions cited. Even though SiC has a higher penetration hardness and inherently greater toughness than Al_2O_3, Fig. 15, the greater reactivity of SiC leads to greater wear in the presence of the fluids cited. However, selection of the more "effective" abrasive will also include the requirements for surface finish and metal-removal rate, and will also reflect the strength and reactivity of the bond used to form the abrasive into a grinding wheel. Thus finish-grinding requirements may sometimes dictate use of bonded SiC, rather than Al_2O_3, to take advantage of the greater reactivity and consequent better surface finish obtained.

George J. Goepfert.[9]
Josephine L. Williams.[10]

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[8] President, Master Chemical Corporation, Toledo, Ohio. Assoc. Mem. ASME.

[9] Director, Chemistry and Abrasives Research Department, The Cincinnati Milling Machine Company, Cincinnati, Ohio.

[10] Senior Research Supervisor, Chemistry and Abrasives Research Department, The Cincinnati Milling Machine Company, Cincinnati, Ohio.

Bearing and Seal Development

Comment by Heinz Hanau[11]

Many of the ideas described in this paper[12] have been discussed, proposed, and generally "procrastinated" for sometime. The refreshing aspect about the author and his work is the fact that he went ahead and tried these ideas—with surprisingly good results.

He has made a valuable and timely contribution to the infant art of high-speed, high-temperature rolling element bearing operation and is to be congratulated for his efforts.

There are several items to be commented on and these will be handled in the order in which they appear in the paper.

1 Regarding the operation of ball bearings at 110,000 rpm, at 500 to 625 F, the problem of outer ring hang-up in the housing as a result of lubricant coking might be minimized by suitable surface treatment of the bearing OD's and housing bores, e.g., chrome plating or a deposit of MoS_2 coating, and still permit the use of the desirable, reversible-type mounting for high-speed operation shown in Fig. 1 of this paper.

Designs, wherein bearings are permitted to float in long sleeves, to which lubricant has no access, could be another approach.

We unfortunately are able to confirm the author's experience regarding the grooving of 440-C stainless-steel outer rings in high-speed bearings. With a given design, both S-Monel and iron-silicon-bronze separators caused grooving in a 204-sized bearing operating at 60,000 rpm with air-oil-mist lubrication of MIL-L-6085A, sometimes within 2 hr of operation.

No such difficulties were encountered under the same operating conditions with 52,100 parts.

To date, our testing has revealed that only a lightweight, wide-land, pressed metal separator of grade-A phosphor-bronze material would operate satisfactorily in stainless-steel rings under these operating conditions.

Slides 1 and 2 show the 1 and 2 piece WD separator types which worked satisfactorily. It appears that attention to design and material can lick the problem of incompatibility with stainless steel.

It is desirable to make 440 stainless-steel bearings work at high-speed operation because this material represents a comparatively inexpensive interim temperature (500 to 600 F) bearing material for turboaccessory applications.

It has been our experience in small high-speed turbines that increasing spring preload will eliminate high-frequency vibrations (screaming) and permit smooth operation. This was accomplished in a JLOO bearing mounting at 120,000 rpm by increasing the preload.

By balancing to 0.000015–0.000020 in./oz, typical unbalance failure conditions have been almost completely eliminated.

We have instrumented our test turbines for recording vibration patterns on a panoramic oscilloscope analyzer.

It was hoped that from these data, some vibration behavior pattern could be determined, but so far we have not been able to interpret the pictures to determine which are the harmful sources of vibration.

Bearing failures in high-speed turbo-accessory due to, as yet unidentified, vibration troubles as well as the more pronounced failures due to rotor unbalance, could be minimized and possibly eliminated by the use of flexible bearing-mounting systems.

This is being tried in the hope of eliminating the expensive balancing operation and increasing bearing reliability, particularly where cost is a factor.

2 Regarding the 1000-F high-speed testing, our experience has indicated that full-type bearings will not give satisfactory performance at very high speeds; viz., a J204 bearing will give short life at 2000 rpm and 1000 F unless it contains a separator. The separator is a necessary evil which brings with it additional problems in high-temperature operation.

Generally, we have found that at low and moderate-speed operation at high temperature, race and ball surfaces are the first to show attrition and failure while at higher speeds ($DN \geq 400{,}000$), both raceways, ball surfaces, and separator-contact surfaces begin to gall and show distress.

An approach, which we are attempting to prove, based on some preliminary encouraging tests, is the use of lightweight, pressed-metal separators, generally of the previously shown construction, with suitable high-temperature coatings for high-speed, high-temperature bearing operation.

We can confirm the author's experience with powdered lubricants. A 206 bearing was operated at 7000 rpm, under 75-lb thrust load with mist injection of MoS_2 for many hours. It became apparent that successful bearing operation would continue as long as the powdered lubricant was supplied at a small but constant rate.

We agree and wish to amplify the author's statement regarding the use of high-temperature bearing materials in their respective temperature range. The more exotic alloys and materials can only be shown to their advantage in the temperature range where the lower performing materials cannot be used.

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[11] Supervisor of Aircraft Projects—New Departure Division of General Motors Corporation, Bristol, Conn.

[12] Stanley Gray, "Bearing and Seal Development," MECHANICAL ENGINEERING, April, 1959, vol. 81, pp. 76–80, condensed from Paper No. 58—Lub-10.

Bearing materials and their temperature range are approximately as follows:

52100	**450 F max**
440 C	**600 F max**
M-50	**750 F max**
M-2	**1000 F max**
Co-Cr-W	**1400 F max**
Sintered carbides	**1800 F max**
Ceramics	**2400 F max**

Co-Cr-W (Stellite) alloys show interesting possibilities as bearing materials in the 1000 to 1400-F range for high-temperature valves and actuators, particularly where corrosive conditions exist.

Since they have a modulus of elasticity comparable to steel and fairly high tensile and hardness properties,

$$(E = 30\text{–}35 \times 10^6 \text{ psi}, s_t = 100{,}000\text{–}150{,}000 \text{ psi})$$

this type of bearing could also be used for high-speed turbine applications.

It has been possible to operate Stellite L02 bearings under 75-lb thrust, at 1500 rpm, for 8 hr, without lubrication at 1200 F. Similar test with a 204-sized bearing at 100-lb thrust was run for 5 hr at 2000 rpm and 1000 F.

3 Regarding the operation of bearings with liquid lubricants in the 700-F range for short-life applications, our laboratory experience has shown it possible to operate 204 ball bearings at 20,000 rpm and 600 F by injecting minute quantities (0.04 cc/sec) of diester oil, and keep such a unit running for several hours.

With suitable coating and separator design, as well as improved techniques of oil introduction, it appears probable that quite reliable operation can be achieved in the 700-F temperature range with oil-mist lubrication on a throwaway basis.

Comment by L. W. McKee[13]

Of great interest in this paper[12] is the extreme speed of 110,000 rpm, which is 1,320,000 dn for the 12-mm bearing used.

This speed coupled with the 500-F temperature represents a most extreme set of conditions, particularly since air is present in the system. It is an indication that the oils per target specification MIL-L-9236 may be significantly better than the commonly used MIL-L-7808 and MIL-L-6085 oils.

The land wear which initially showed up at this high speed was rectified by modifying the retainer clearances by a small amount. This serves to indicate the great importance of these clearances at extreme speed.

The success of the test with the silicone lubricant at 75,000 rpm is surprising as silicones normally are unsuccessful at high speeds. Perhaps, this success is due to the unusually high temperature. Further work in this area might be fruitful.

The vibration test results show that accurate balancing alone cannot compensate for shaft deflection and points up the need for accuracy in bearings, shafts, spacers, rotor hubs and nuts, and the desirability of integral shaft designs, at extreme speeds.

The test results at 1000 F demonstrate that selected bearing materials will withstand extreme temperature and that lubrication is the limitation. Powdered lubricants are shown to be successful at moderate speeds but it must be remembered that powdered lubricants do not approach liquid lubricants in their ability to remove heat; hence, the speed and load conditions must be maintained at moderate levels. The author's continuing investigation of combinations of mixtures of liquid and powder lubricants should be fruitful as the liquid portion should effectively carry off heat as it vaporizes while the powder will remain to lubricate. This may permit higher speeds under heavier loads, perhaps approaching those possible with oil at lower temperature.

Author's Closure

The following are the author's comments on the written discussions by Mr. Hanau and Mr. McKee.

The author appreciates these interesting comments and takes this opportunity of expressing his thanks to them and their respective companies for the support given on some of the work described in the paper.

Replying first to Mr. Hanau; special coatings such as graphite and MoS_2 were tried in the cartridges and on the bearing outer diam in the 110,000 rpm, high-temperature tests to overcome bearing hang-up. The coatings were found to be effective for only a limited period at high temperature before lubricant coking would cause hang-up to occur. A flexible bearing-mounting system as referred to for overcoming balancing and vibration difficulties would possibly also solve bearing hang-up. Publication of data on successful flexible mountings would be of great value.

The problem of grooving of 440-C bearing outer rings by the retainers at very high speeds appears to have been solved by the careful detailed development of the retainer and retainer to bearing compatibility. Several high-speed accessories are not operating successfully with this bearing material.

Regarding retainers for 1000-F high-speed ball bearings with powdered-type lubricants, subsequent work has shown that high-strength retainers can be developed, that in terms of life, will exceed the wear limitations of the ball and race components.

Materials for extremely high-temperature bearings did not appear to be receiving the research support going into lubricants. It is, therefore, encouraging to see the work being done in developing new tool steels for bearings (WADC Tech. Report 57–343, Part 2, by Philip, Nehrenberg, and Steven, of Crucible Steel Co., October, 1958) and it is hoped that similar effort will soon be put into the more exotic materials such as Stellite and carbides, to achieve the optimum compositions necessary in bearings.

Turning to the comments of Mr. McKee, the author agrees with the importance and value of the MIL-L-9236-type lubricants and notes the progress in developing a fluid to meet the MIL-L-9236 spec., as reported by K. L. Berkey, of WADC Propulsion Lab. (The Proceedings of the Air Force-Navy-Industry Conference on Lubricants, February, 1959, at Dayton, Ohio).

Regarding 1000-F bearing operation and the use of combined liquid and powdered lubricants—in some applications the temperature environment would be so high that vaporization would occur before the combined lubricant could reach the bearing, hence no cooling could be expected. The bearing material would have to temperature stabilize and survive in the applied and generated temperature. Two advantages of the combined liquid and powdered lubricant are: Ease of controlling the quantity of powder being supplied, and liquid lubrication of the bearing at start-up and in the lower-temperature range where the powder may be a marginal lubricant.

S. Gray.[14]

Whirling

Comment by Dr. E. Downham[15]

The subject of shaft whirling and vibration has been of interest to me for a number of years, and it gives me great pleasure when hitherto unknown aspects of the subject are demonstrated. It is only in recent years that any real effort has been expended on the solution of whirling problems and there is still a good deal to learn on the subject. Consequently on reading this paper[16] I was most interested to find that he had uncovered a new aspect of shaft whirling which has hitherto not been appreciated. The fact that coupling between torsional and whirling vibrations is possible may well account for many unsolved problems associated with failure of rotating shaft systems, and must be an important consideration in future designs.

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[13] Chief product engineer, The Barden Corporation, Danbury, Conn.

[14] Senior project engineer, Stratos Division, Fairchild Engine and Airplane Corporation, Bay Shore, L. I., N. Y.

[15] Reader in Mechanical Engineering, College of Technology, Birmingham, England.

I would hesitate to criticize the author's paper because regardless of detail it has served a most useful purpose in indicating a new field of approach both as regards further experimental work and also from the purely theoretical viewpoint.

However, on points of detail in the second paragraph of the introduction, I am credited with investigating forced frequencies at rotative speeds below those of the natural frequencies, which is not strictly true, as in my experiments rotational speeds were, in general, up to and above the whirl frequencies.

My only other comment is with regard to terminology. The author has defined whirl as a lateral vibration superimposed on rotation. In general vibration work, a lateral vibration is one involving linear oscillations in a transverse plane as distinct from vertical or fore and aft. In the whirling case the natural vibrations are usually composed of lateral and vertical vibrations with ±90-deg shift, resulting in either forward or backward whirls of circular or elliptic shape (elliptic if there is asymmetry in the system). I would prefer, therefore, to call the natural whirling vibrations "circular" rather than "lateral." The danger with the original definition is that it may be misleading, particularly when considering a perfectly balanced shaft rotating at an arbitrary speed.

Neglecting the inertial effects on the rotor, the whirl amplitude would be zero, and if the shaft were to receive a lateral impulse it would vibrate linearly and the result would be a lateral vibration with rotation, which is not a whirl in the accepted sense.

In conclusion, I would like to take the opportunity of congratulating the author on a fine piece of original work which has brought to light a new aspect of shaft whirling.

Author's Closure

The author wishes to thank Dr. Downham for his remarks. Regarding the statement relative to Dr. Downham's experimentation, it was intended only to indicate that he had been able to establish experimentally the natural frequencies derived from the equations. With regard to the definition of whirling made by the author, it was a case of oversimplification of the phenomena. The author, therefore, bows to the more exact definition of whirling given by Dr. Downham.

C. M. Lowell.[17]

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[16] C. M. Lowell, "Lateral Vibrations in Reciprocating Machinery," MECHANICAL ENGINEERING, April, 1959, vol. 81, pp. 74–75, condensed from Paper No. 58—A-79.

[17] Engineering supervisor, Compressor and Engine Division, Worthington Corporation, Buffalo, N. Y. Assoc. Mem. ASME.

Notes on
Books Received
in Engineering
Societies Library

REVIEWS OF BOOKS

Technical Writing

Successful Technical Writing

By Tyler G. Hicks. McGraw-Hill Book Company, Inc., New York, N. Y., 1959. Cloth, $5^1/_2 \times 8^1/_2$ in., figs, tables, index, xi and 294 pp., $5.50

Reviewed by Maurice Barrangon[1]

A CASE can be made for the following proposition: Writing is the most difficult of the arts, demanding the most imagination, the most thought, the most skill. It can take ten hard years to become an accomplished writer. This, of course, refers to creative writing, which not only speaks with clarity but generates a mood. Technical writing makes fewer demands. But it requires more skill than most technical writers think it does, which is one reason they do it so badly.

There are two people who can help a writer: Another writer, and an editor.[2] This book offers the beginner a chance to commune—long and exhaustively—with a man who is both author and editor.

Mr. Hicks has written more than 1000 published technical articles, and three books besides this one. For years he served as an editor on *Power* magazine, and he is now an editor for the McGraw-Hill Book Company. Wherever you stand in your progress toward writing competence, Mr. Hicks has been there. He knows your problems.

His book is a comprehensive study (indefatigable might be the word) of the methods and techniques of technical writing. The chapter headings divide the business into neat compartments, and the reader may prefer to read them in some other order than that in which they appear. The beginner is rarely concerned with "How to Find and Develop Article Ideas" (chapter 3). More likely he is bogged down in his first technical paper, feeling lost. Chapter 10 ("How to Write Technical Papers") could get the show back on the road. A steady literary output will come later—much later.

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[1] Editorial Department, ASME.

[2] Teachers are intentionally omitted. Leading the beginner by the hand, they postpone the day when he can blast his own literary path.

The young engineer will be fortunate if he gets hold of this book and reads chapter 1. There the author tackles the question, "Why write at all?" His answers are solid, having to do with money, professional recognition, sharpening one's own thinking, prestige, and money.

Many an engineer's career may be enriched by the early discovery of what publication can do for him.

The way to learn to write is to study good published writings, and the author is generous with examples of superior technical literature. But the ambitious engineer can find his own examples—and should, and will. The book's real value is its one-author-to-another stimulus, an old hand telling the beginner the methods that worked for him, and the pitfalls he has encountered.

Chapter 5 ("You Can Work With Editors") deserves special attention. Here the author states: "Half the fun of technical writing is working with editors...editors are alert, intelligent, informed." That's right. And editors will be most thankful if authors will read and take to heart the section on page 61 which lists seven ways to irritate editors; among them, "scream at the rewrite of your golden words." All seven are efficient, fire-tested methods for hardening the heart of an otherwise kindly editor.

At the end of each chapter there is a questionnaire to determine if you have learned your lesson. Perhaps the author's experience as a teacher (he teaches mechanical engineering at Cooper Union) convinces him that the student must verbalize what he has seen. To the graduate reader who has just enjoyed the first chapter it comes as a jarring note to discover that teacher is rapping for attention, and that one must now recite.

This reporter's distress may have stemmed from the fact that he couldn't answer more than half the questions. Nevertheless, you take a book into your home, you treat it like one of the family, and you'd like to think you could finish a chapter without being hit in the face with a quiz.

But this is ignoring the real purpose of this book. In truth, the aspiring engineer would do well to take these tests—and score high on them. Because the book contains solid advice on writing, and writing is an accomplishment that can bring many rewards to the professional man.

American Water Development

Technology in American Water Development

By E. A. Ackerman and G. O. G. Löf. The John Hopkins Press, Baltimore, Md., 1959. Cloth, $6\frac{1}{4} \times 9\frac{1}{4}$ in., figs, tables, references, glossary, index, xv and 710 pp., $10.

Reviewed by E. P. Partridge[3]

Here is a wide-ranging exploration of how new ways of doing all sorts of things have affected one of our major problems—providing enough water in usable condition where and when it is needed by our burgeoning civilization. This is not a handbook, nor is it a superficial review of the wonderful achievements of the scientist and engineer. It is an objective study, full of all kinds of information thoughtfully digested and arranged, with references to a thousand sources ranging from "The Education of Henry Adams" to "The Use of Tritium for Determining the Age of Ground Water."

What were the authors trying to accomplish? On the one hand, to "bring the technical horizon into better focus for businessmen, social scientists, administrators, and lawyers interested in water development and management"; on the other hand, to "help to introduce engineers and physical scientists to the administrative problems and opportunities which stem from their works."

The scope of the 22 chapters is broad. How water occurs in the United States, how it is used, and the problems of balancing supply and demand are first presented. Then comes a discussion of how some technical developments, such as refrigerated transport, irrigation, growth of the chemical industry, and increase in the use of electricity, have boosted the demand for water, while others, such as the use of saline waters, spray disposal of wastes from canning plants, and changes in the technology of producing paper pulp may decrease the amount of water needed.

Storage of water, both in reservoirs and underground, management of land to conserve water, and improvement of water by softening and demineralization provide examples of techniques for extending the use of a given unit supply. And by doing things on a larger scale we can do them more economically, for example, digging canals and tunnels, moving earth and building dams, controlling flow on a drainage system with multiple reservoirs, transmitting electricity, and planning for the dispersal of the demand for water. Technical developments for providing more water range from improved methods for drilling wells, increasing the flow into them, and pumping the water from them, to control of reservoirs to overcome malaria.

Looking ahead, the authors consider the probable effects of continuing technical improvement in thermal methods of generating electricity, the utilization of nuclear energy, use or beneficiation of saline waters, weather control, techniques for locating underground water supplies, reuse of water by industry, more economical use of water in irrigation, reduction of evaporation from reservoirs. Then they take a deep breath before plunging into the last 200 pages dealing with the past, present, and future adjustment of our social machinery to continuing technologic change.

This part can be particularly tough reading for the engineer absorbed in his own technical specialty. But it can be rewarding to anyone who likes at least occasionally to shift his focus to a plane more distant than the tangent between his nose and the grindstone.

How are we to do the tremendous job of planning and carrying through the development and operation of our water resources with the maximum benefit to all of us at the lowest cost? The authors make no attempt to expound an explicit answer. They do seem to suggest, however, that we need federal regional agencies for the administration of each river basin, with a centralized federal organization providing co-ordination and imaginative technical leadership. The book ends with a call for "an early reconsideration of national water policy and national water development organization."

Resources for the Future is a nonprofit organization financed by grants from the Ford Foundation. Until the fall of 1958, its studies in water resources were directed by E. A. Ackerman, one of the authors of the present book, who previously had served as assistant general manager of the Tennessee Valley Authority and as professor of geography at the University of Chicago. G. O. G. Löf is a chemical engineer, a consultant to the Office of Saline Water, Department of the Interior, and an authority in the field of solar energy.

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[3] Director, Hall Laboratories Division, Hagan Chemicals and Controls, Inc., Pittsburgh, Pa. Mem. ASME.

Cost Manual for Piping and Mechanical Construction

By Herbert Herkimer. 1958, Chemical Publishing Company, Inc., New York, N. Y. 176 p., $6^{1}/_{2} \times 9^{1}/_{2}$ in., bound. $10. The purpose of this volume is to help estimators to arrive at reliable figures as well as to provide plant-maintenance managers and engineers with a means of checking estimates. Following preliminary material on plant and service accounts, types of estimates, standard hours, direct costs, and pay statements, tables are presented on piping installation, mechanical construction, comparative unit-costs, and miscellaneous data. The tables provide unit costs calculated in man-hours, and therefore are not subject to constant changes in labor cost.

Transport Processes in Statistical Mechanics

Edited by I. Prigogine. 1958, Interscience Publishers, Inc., New York, N. Y. 436 p., $6^{1}/_{4} \times 9^{1}/_{4}$ in., bound. $10. Among those aspects dealt with in this volume are statistical mechanics and the Boltzman equation; gravitational forces and dynamic friction; statistical mechanics of the steady state; diffusion in velocity space and transport phenomena; a mathematical treatment of diffusion in gas mixtures; the theory of transport phenomena in solids; quantum statistics; the definition of entropy in magnetic resonance; cyclic processes in irreversible thermodynamics; thermal conductivity in gases; the diffusion of tracers through solids. This volume constitutes the proceedings of an international symposium held in Brussels in 1956.

Decision-Making and Productivity

By Seymour Melman. 1958, John Wiley & Sons, Inc., New York, N.Y. 260 p., $5^{1}/_{2} \times 8^{1}/_{2}$ in., bound. $7. The author attempts to show that major alternatives in industrial decision making exist and have discernible effects on productivity. He also attempts to define some of the opportunities that exist for accelerating the growth of productivity. The book is divided into four sections covering alternative methods for productivity growth, decision making by the union, decision making by management, and the effects of union and management decision making on productivity.

Handbook of Industrial Loss Prevention

By the Staff of the Factory Mutual Engineering Division. 1959, McGraw-Hill Book Company, New York, N. Y. Various pagings, $7^{1}/_{2} \times 10$ in., bound. $20. The fundamental principles, procedures, and reference data for protecting factories and processes against destruction and damage are given. Topics covered are safe construction, automatic sprinkler systems and water supplies, safeguards for processes involving flammable liquids or gases, protection of high storage values, elimination and control of ignition sources, anchoring roofs against wind, earthquake protection, and other preventive measures. Tested equipment used by industry to prevent losses are described, as are many newly developed methods.

Kolbenringe. Volume II. Betriebsverhalten und Prüfung

By Carl Englisch. 1958, Springer Verlag, Vienna, Austria. 331 p., $6^{3}/_{4} \times 9^{3}/_{4}$ in., bound. 64 DM. Vol. I of this two-volume set dealt with the theory, materials, and manufacture of piston rings. The present volume discusses in detail their application and properties under operating conditions. Topics covered include the effectiveness of various ring types, thermal stress in piston rings, wear, oil consumption, sticking and breaking difficulties, and test methods.

BOOKS RECEIVED IN LIBRARY

Kongress fur Heizung und Lüftung, 16th, 1957

Published 1958 by R. Oldenbourg, Munich, Germany. 240 p., $6^{3}/_{4} \times 9^{1}/_{2}$ in., paper. 34 DM. Seven papers with discussion, comprising the proceedings of the conference on heating and air conditioning held in Berlin in 1957. The papers deal with developments since the last (1938) meeting; multidwelling apartments; modern techniques of heating and ventilating; municipal heating installations; distribution of heat-carrier water; boiler installations; and recent air-conditioning methods.

Processing of Thermoplastic Materials

Edited by E. C. Bernhardt. 1959, Reinhold Publishing Corp., New York, N. Y. 690 p., $6^{1}/_{2} \times 9^{1}/_{4}$ in., bound. $18. A review of the engineering fundamentals on which the design of plastics-processing equipment is based, and of the practical application of these concepts to thermoplastics-processing problems. The first section covers the flow behavior of thermoplastics, heat transfer, thermodynamics, mixing, and dispersing. The second deals with applications, and includes extrusion, injection molding, calendering, mixing and dispersing processes, sheet forming, forming of hollow articles, and the sealing and welding of thermoplastics. The concluding section discusses processing properties.

Technische Baustähle

By W. Küntscher and others. 1958, Wilhelm Knapp Verlag, Halle (Saale), Germany. 742 p., $7 \times 9^{3}/_{4}$ in., bound. 37 DM. A comprehensive manual and reference book on the properties, treatment, application, and testing of structural steels intended primarily for the practical engineer or designer as an aid to the rapid selection of suitable steels for specific applications. The first and major part of the volume, on properties, is classified by the main types of steel. Certain specialized aspects are dealt with in an appendix. Detailed indexes to the steels considered and to the other topics of interest are included.

Analyses of Industrial Operations

Edited by E. H. Bowman and R. B. Fetter. 1959, Richard D. Irwin, Inc., Homewood, Ill. 485 p., $6^{1}/_{4} \times 9^{1}/_{4}$ in., bound. $9.55. Case studies that show the actual application of quantitative methods to the analysis of industrial-operating problems. The studies included are arranged according to method of analysis, and sections are given dealing with applications of linear programming, other programming applications, waiting-line applications, total cost and value models, and applications of incremental analysis. The studies selected are intended to illustrate the simplifications, assumptions, method modifications, data needed, action, and results associated with operations analyses.

Anwendung von Rechenmaschinen Bei der Berechnung von Regelvorgängen

Edited by W. Oppelt. 1958, R. Oldenbourg, Munich, Germany. 128 p., $6^{1}/_{4} \times 9^{1}/_{2}$ in., bound. 13.50 DM. This symposium, held in 1957 by the Fachausschuss Regelungsmathematik of the Gesellschaft für angewandte Mathematik und Mechanik, contains ten papers on the use of computers in setting up control-engineering processes, of which one, "A Simple, Graphical Method for Deconvolution," by J. B. Reswick, is in English. Although most of the papers deal with applications of analog computers, there is one comparison of the use of various computer types in control engineering.

Book of ASTM Standards, 1958

Published 1959 by the American Society for Testing Materials, Philadelphia, Pa. 10 vols., $6^{1}/_{4} \times 9^{1}/_{4}$ in., bound. $116. The triennial compilation of ASTM Standards, expanded in this edition from seven to ten parts occupying 13,600 pages. A total of 2450 standard specifications, methods of test, definitions of terms, and recommended practices are included in the various sections which deal with ferrous metals specifications; nonferrous metals specifications; methods of test for metals; cement, concrete, mortars, road materials, waterproofing, soils; masonry products, ceramics, thermal insulation, sandwich and building constructions, acoustical materials, fire tests; wood, paper, adhesives, shipping containers, cellulose, leather; petroleum products, lubricants, tank measurements, engine tests; paint, naval stores, aromatic hydrocarbons, coal, coke, gaseous fuels, engine antifreezes; plastics, electrical insulation, rubber, carbon black; textiles, soap, water, atmospheric analysis, wax polishes. The volumes are available separately.

Cerenkov Radiation and Its Applications

By J. V. Jelley. 1959, Pergamon Press, Inc., New York, N. Y. 304 p., $5^{1}/_{2} \times 8^{3}/_{4}$ in., bound. $10. The classical treatment of the normal Cerenkov effect in isotropic media is presented in detail, together with an account of the underlying physical basis of the phenomenon. For the numerous and varied special cases such as anisotropic media and ferromagnetics, only the results of studies are given, and for detailed mathematical treatments the reader is referred to other sources. Emphasis is placed on the general properties and applications of counters of various types, with inclusion of sufficient technical data to allow the design to be worked out for an instrument for any particular purpose.

Conduction of Heat in Solids

By H. S. Carslaw and J. C. Jaeger. Second Edition. 1959, Oxford University Press, New York, N. Y. 510 p., $6^{1}/_{4} \times 9^{1}/_{2}$ in., bound. $13.45. This edition has been expanded to provide as complete an account of the subject as can be encompassed in one volume. To achieve this purpose, many new results have been added and certain parts of the discussion have been extended as is the case with heat generation, surface heating, geophysical applications, anisotropic media, moving media, and substances with variable thermal properties. Three new chapters dealing with melting and freezing, integral transforms, and numerical methods as well as a number of new tables and text figures giving numerical information also have been added.

Deutscher Ausschuss für Stahlbau 1908–1958

Published 1958 by Stahlbau-Verlag-GMBH, Köln, Germany. 150 p., $7^{1}/_{2} \times 10^{3}/_{4}$ in., bound. 15 DM. The first of the 12 papers in this volume discusses the work of the German Committee on Steel Construction over the 50 years of its existence. The succeeding papers review developments within the same period in steel-construction materials, brittle-fracture problems, buckling theory, bridge load and strength analysis, composite construction, light construction for highway bridges, rigid bolted joints, and other topics.

Electromechanical Energy Conversion

By D. C. White and H. H. Woodson. 1959,

John Wiley & Sons, Inc., New York, N. Y. 646 p., 6 × 9$^{1}/_{4}$ in., bound. $12.50. The fundamentals of analytical dynamics are used to establish a base for understanding the interactions in an electromechanical system. The first part of the book stresses dynamics, interconnected systems, and feedback control theory, while the second part gives detailed and specialized treatments of transducers, commutator machines, induction machines, and synchronous machines. To illustrate the unity that exists in the analysis of machines, a two-phase model of an electric machine is developed and its equation of motion derived and used in all the machine analyses of later chapters.

Étude D'Une Plaque Rectangulaire Raidie Par Duex Poutres de Rive

By Z. Hashin. 1958, published by Association Française de Recherches et d'Essais sur les Materiaux et les Constructions. Distributed by Librairie Eyrolles, Paris, France. 141 p., 8$^{1}/_{4}$ × 10$^{1}/_{2}$ in., paper. 2,600 Fr. A theoretical and experimental study of the resistance to stress of thin rectangular plates reinforced by parallel supporting beams. The problem is first studied mathematically and a formula for determining the deflection and bending of plates under vertical loads is obtained. The second part describes an experimental study on the basis of this formula, utilizing a steel model. The results of the theoretical and experimental studies are then compared. Number 7 in the series Cahiers de la Recherche Théorique et Expérimentale sur les Matériaux et les Structures.

Gütebestimmung an Technischen Oberflächen

By Herbert Schorsch. 1958, Wissenschaftliche Verlagsgesellschaft, Stuttgart, Germany. 186 p., 6 × 8$^{1}/_{2}$ in., bound. 28.50 DM. A book on surface-quality measurements for designers, laboratory workers, students, and engineers. It reviews German and foreign standards, describes measurement methods and equipment, and gives practical tips on evaluating the effectiveness of these methods.

The Heat-Treatment of Steel

By Edwin Gregory and E. N. Simons. Second Edition. 1958, Sir Issac Pitman and Sons, Ltd., London, England. 381 p., 5$^{1}/_{2}$ × 8$^{3}/_{4}$ in., bound. 35s. All phases of the subject are discussed, including pyrometry, furnaces, atmosphere control, and quenching media. In addition, the various classes of steel and their heat-treatments are described as are also austempering and martempering, subzero treatment, and new steels required by the plastics industry. Some sections, including that on magnet steels, have been rewritten and others considerably amplified.

Hütte. Taschenbuch für Betriebsingenieure. Band 2. Betrieb.

By The Akademischer Verein Hütte E.V. in Berlin. Fifth Edition. 1957, Wilhelm Ernst & Sohn Verlag, Berlin, Germany. 810 p., 6$^{1}/_{4}$ × 9$^{1}/_{2}$ in., 66 DM. This second volume of a two-volume handbook for management engineers includes the following sections: planning, construction, and equipment of manufacturing plants; service utilities; factory management and organization; mathematical and physical formulas and data, including conversion tables. All sections have been revised and enlarged to conform with current practice.

Hydraulic Turbines

By Miroslav Nechleba. 1957, Constable and Company, Ltd., London, England. 636 p., 6$^{1}/_{4}$ × 8$^{1}/_{2}$ in., bound. 45s. An English translation of the Czech edition, this treatise is concerned with the design of hydraulic turbines of the Francis, Kaplan, and Pelton types, and their associated equipment, including controllers, thrust bearings, and conduits. In the solution of designing problems requiring special calculations in the field of hydraulics, the theoretical bases for these calculations are developed in conjunction with the specific problem studied.

LIBRARY SERVICES

Engineering Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

The Industrial Cooling Tower

By K. K. McKelvey and Maxey Brooke. 1959, D. Van Nostrand Company, Inc., Princeton, N. J. 429 p., 6 × 9 in., bound. $15.75. A great deal of widespread data has been collected and digested by the authors, who have combined it with their own experience to provide a co-ordinated survey of the whole field of cooling-tower technology. Among those aspects treated are heat transfer in cooling towers; the natural draft cooling tower; cooling-tower packing arrangements; drizzle precipitation, carry-over, and wind effects; cooling water treatment; the structural design of cooling towers; auxiliary equipment, such as pumps and fans; and the construction of cooling towers. Both a theoretical and practical approach are provided.

Jet Propulsion Engines

(High-Speed Aerodynamics and Jet Propulsion, Vol. 12.) Edited by O. E. Lancaster. 1959, Princeton University Press, Princeton, N. J. 799 p., 6$^{1}/_{2}$ × 9$^{3}/_{4}$ in., bound. $20. Presents the principles and problems encountered in combining components to form a complete engine. Following a discussion of the basic concepts common to most types of engines, the turbojet, turboprop, ramjet, the intermittent jets, and the solid propellant rocket engines are then considered in turn. The various sections on these engines examine those problems peculiar to each involving performance, control, testing, installation, and matching the various components. Similar analyses are presented for two of the hybrid types, the ram rocket and the jet rotor. Finally, the use of atomic energy in jet propulsion and other future prospects are considered.

Machine Tools for Engineers

By C. R. Hine. Second Edition. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 445 p., 6 × 9$^{1}/_{4}$ in., bound. $7.75. The uses and mechanics of machine tools are treated from the standpoint of the engineer who is chiefly concerned with the performance functions of the various machine tools rather than in how they are operated. In this edition new tools and machine processes are included such as chemical milling, electrical-discharge machining, ceramic tools, the Floturn lathe, electric broaching, and skin milling. A new chapter on automatic machine tools also is included. Additional sketches and diagrams have been added to clarify the important motions and adjustments.

Manual on Rockets and Satellites

Edited by L. V. Berkner. 1958, Pergamon Press, Inc., New York, N. Y. 508 p., 7$^{1}/_{2}$ × 9$^{3}/_{4}$ in., paper. $25. Inasmuch as the techniques for exploring the environment by means of rockets and satellites are so recent, this manual takes the form of a series of scientific papers derived from the best of the scientific literature available, selected to provide a guide for those who will make observations in the field or conduct theoretical or experimental activities. The manual is broadly broken down into sections containing papers based on the IGY Rocket Program and the IGY Earth Satellite Program, and in addition contains an extensive bibliography. A wide variety of aspects pertinent to each area is included.

Mechanical Engineering Problems

By William Glendinning. 1959, published by the author, 5123 Bell Boulevard, Bayside, N. Y. 96 p., 8$^{1}/_{2}$ × 11 in., paper. $3. Provides typical problems selected from past examinations in professional engineering given by the N. Y. State Board of Examiners. Those included are taken from mechanical engineering, part 3. Answers are given for all the problems included.

Die Metallischen Rohstoffe
Band 11: Zinn und Wolfram.

By Friedrich Ahlfeld. 1958, Ferdinand Enke Verlag, Stuttgart, Germany. 212 p., 6$^{1}/_{4}$ × 9$^{3}/_{4}$ in., bound. 48 DM. This 11th volume in a series on metal resources covers tin and tungsten. Each of the two sections begins with a brief survey of properties, history, occurrence, origin, mining, markets, and statistics. The rest of each section is devoted to condensed descriptions of the location and type of deposits in all of the important producing countries.

Oil Well Drilling Technology

By A. W. McCray and F. W. Cole. 1959, The University of Oklahoma Press, Norman, Okla. 492 p., 6$^{1}/_{4}$ × 9$^{1}/_{2}$ in., bound. $9.95. The result of extensive research and practical investigation, this volume discusses the geological and geophysical principles governing oil accumulation and the drilling of wells from the standpoint of the driller, petroleum engineer, geologist, and student. Following a survey of the geological formations likely to contain deposits of oil, it proceeds to methods of discovery, including modern seismic and radioactive prospecting methods, and continues with various types of drilling and drilling tools, cementing operations, and the costs of drilling.

Plastic Design in Steel

Published 1959 by the American Institute of Steel Construction, New York, N. Y. 93 p., 8$^{1}/_{2}$ × 11$^{1}/_{4}$ in., bound. $4. Methods are given for designing continuous steel structures on the basis of their ultimate or plastic strength. The chapters contained deal with plastic theory applied to bending, effect of axial load on bending resistance, shear and web crippling, bracing requirements, nonsymmetrical sections, haunched connections, design of continuous beams, design of single-span rigid frames, and design of multispan rigid frames.

Precipitation From Solid Solution

By R. F. Mehl and others. 1959, The American Society for Metals, Cleveland, Ohio. 517 p., 6 × 9$^{1}/_{4}$ in., bound. $10. Among the topics discussed are general theory, mechanism, and kinetics; precipitation hardening-base alloys; magnesium alloys; precipitation hardening of copper alloys; age-hardening characteristics of nickel-chromium alloys; precipitation reactions in irons and low-alloy steels and in iron-base alloys; precipitation in cobalt-base alloys. These papers constitute a series of lectures presented at the National Metal Congress, held in Chicago, Ill., in 1957.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

(The following Case Interpretations were formulated at the Committee meeting June 3, 1959, and approved by the Board on July 30, 1959.)

Annulment of Cases

Case No.	Reasons for Annulment
1023	Essence of Case included in the Addenda to 1959 Edition of Section VIII under revised Part UB (Brazing)
1174	Fig. UNF-28.13 now included in Addenda to 1959 Edition of Section VIII
1201	As noted in May, 1959, Mechanical Engineering
1222	Stress values now included in Table UNF-23; and Fig. UNF-28.19 included in Addenda to 1959 Edition of Section VIII
1230	Essence of Case included in the Addenda to 1959 Edition of Section VIII under revised Part UB (Brazing)
1247	Stress values now included in Table UNF-23, Addenda to 1959 Edition of Section VIII
1248	Essence of Case included in Table QN-11.1, Figs. Q-8 and QN-8; and Note 6 of Figs. Q-8.1 and QN-8.1

Case 1236-1

(*Reopened*) (*Special Ruling*)

Forgings, SA-336 Modified

Revise Item (3) of the Reply as follows:

(3) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX. A separate procedure and performance qualification shall be made for this material. Welding procedure qualification in accordance with Section IX shall be performed on test plates subjected to the same heat treatment before and after welding as will be used in fabrication.

Add Item (4) to the Reply as follows:

(4) Material subjected to accelerated cooling as outlined in (b) of the Inquiry shall not be subject to the prohibition of welding as outlined in Pars. UF-5(c) and UF-32(a), or to the heat treatment required by Par. UF-31(b) after all repair welding is completed.

Case 1241-1

(*Reopened*) (*Special Ruling*)

Carbon Steel Forgings, SA-105

Add to the Reply the following:

...with the following additional requirements:

(1) Welding procedure qualification in accordance with Section IX shall be performed on test plates of this material subjected to the same heat treatment before and after welding as will be used in fabrication.

(2) Material subjected to accelerated cooling as outlined in (a) of the Inquiry shall not be subject to the prohibition of welding as outlined in Pars. UF-5(c) and UF-32(a), or to the heat treatment required by Par. UF-31(b) after all repair welding is completed."

Case 1243-1

(*Reopened*) (*Special Ruling*)

$3\frac{1}{2}$ Per Cent Nickel Steel Forgings

Add to the Reply the following:

(c) Welding procedure qualification in accordance with Section IX shall be performed on test plates of this material subjected to the same heat treatment before and after welding as will be used in fabrication.

(d) Material subjected to accelerated cooling as outlined in (a) of the Inquiry shall not be subject to the prohibition of welding as outlined in Pars. UF-5(c) and UF-32(a), or to the heat treatment required by Par. UF-31(b) after all repair welding is completed.

Case 1254-1

(*Reopened*) (*Special Ruling*)

AISI Grade D-319 and D-319L Stainless Steel (Type 316 Modified)

Inquiry: It is sometimes considered desirable to modify the standard chemical composition ranges of Types 316 and 316L stainless steels. For Code construction, will it be acceptable to use grades designated as AISI D-319 and D-319L having the following chemical compositions:

	D-319	*D-319L*
Carbon, max, per cent	0.07	0.03
Manganese, max, per cent	2.00	2.00
Silicon, max, per cent	1.00	1.00
Phosphorus, max, per cent	0.045	0.045
Sulfur, max, per cent	0.030	0.030
Chromium, per cent	17.50–19.50	17.50–19.50
Nickel, per cent	11.0–15.0	11.0–15.0
Molybdenum, per cent	2.25–3.00	2.25–3.00

Reply: It is the opinion of the Committee that steels having chemical compositions as stated in the Inquiry and designated Type D-319 or Type D-319L may be used for Code construction under all the rules applicable to stainless steels Types 316 or 316L, respectively. The allowable stresses for D-319 shall be those specified for Type 316 and the allowable stresses for D-319L shall be those specified for Type 316L. The qualification of Procedure and Performance in Section IX for Types 316 and 316L shall apply. The requirements of Par. UA-51-(b) (3) calling for impact tests for operating temperatures below −20 F shall not apply.

Case 1255-1

(*Reopened*) (*Special Ruling*)

S4-350 Grade LF-1 Forgings with Added Nickel

Add to the Reply the following:

...with the following additional requirements:

(1) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX. A separate procedure and performance qualification shall be made for this material. Welding procedure qualification in accordance with Section IX shall be performed on test plates subjected to the same heat treatment before and after welding as will be used in fabrication.

(2) Material subjected to accelerated cooling as outlined in (2) of the Inquiry

shall not be subject to the prohibition of welding as outlined in Pars. UF-5(c) and UF-32(a), or to the heat treatment required by Par. UF-31(b) after all repair welding is completed.

Case 1266

(*Special Ruling*)

Use of 70/30 Copper-Nickel Tubes

Inquiry: May 70/30 copper-nickel tubes in the drawn, stress-relieved temper, with mechanical properties as follows:

Tensile Strength—72,000 psi, min
Yield Strength (0.5 per cent extension under load)—50,000 psi, min
Elongation in 2 inches—15 per cent, min
Expansion of tube inside diameter with tapered pin—20 per cent, min

and otherwise conforming with the requirements for this alloy in Specification SB-11 be used in ASME Boiler and Pressure Vessel Code construction?

Reply: It is the opinion of the Committee that 70/30 copper-nickel tubes in the drawn, stress-relieved temper, as described in the Inquiry, may be used for ASME Boiler and Pressure Vessel Code construction.

The maximum allowable stress values to be used in the design formulas where reference is made to Table UNF-23 are as follows:

Temperature F	Allowable Stress Values, psi
100	18,000
150	17,500
200	17,100
250	16,700
300	16,400
350	16,000
400	15,700
450	15,400
500	15,100
550	14,700
600	14,600
650	14,500
700	14,400
750	14,400
800	8,000

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the semiannual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1959

Table P-6 under Copper Alloys, Castings Revise Table as follows:

Casting Materials	Grade, Type, or Name	Specified Tensile Strength psi	Minimum Yield Strength psi	Notes	For Metal Temperatures Not Exceeding Deg F 150	200	250	300	350	400	450	500	550
SB-61	Bronze	34,000	16,000	(3)	8400	8300	8200	8100	7900	7600	7200	6600	5000
SB-62	Brass (85-5-5-5)	30,000	14,000	(3)	7300	7100	6900	6800	6600	6500	....	....	....

Under Notes add the following Note (3):

(3) In the absence of evidence that the casting is of high quality throughout, values not in excess of 80 per cent of those given in the table shall be used. This is not intended to apply to valves and fittings made to recognized standards.

Unfired Pressure Vessels, 1959

PAR. UG-46(c) Revise to read:

Vessels under air pressure which also contain other substances which will prevent corrosion need not have openings for inspection only, providing the vessel contains suitable openings through which inspection can be made conveniently, and providing such openings are equivalent in size and number to the requirements for inspection openings in (f).

PAR. UG-116(h) Revise to read:

(h) Parts of vessels for which partial data reports are required in Par. UG-120-(b) shall be marked with the following:

(1) The official Code Symbol shown in Fig. UG-116(a), above the word "PART."
(2) The manufacturer's name
(3) The manufacturer's serial number

This requirement does not apply to such items as handhole covers, manhole covers and accessories.

TABLE UNF-23 under Casting Material, Copper and Copper Alloys Revise Table as follows:

Casting Materials	Specified Tensile Strength, psi	Minimum Yield Strength, psi	For Metal Temperatures Not Exceeding Deg F 100	150	200	250	300	350	400	450	500	550
Bronze SB-61 (2)	34,000	16,000	8500	8400	8300	8200	8100	7900	7600	7200	6600	5000
Brass (85-5-5-5) SB-62 (2)	30,000	14,000	7500	7300	7100	6900	6800	6600	6500	....	....	...

Welding Qualifications, 1959

TABLE Q-11.2 Revise to read as shown in the accompanying table.

TABLE Q-22 Add the accompanying table.

PAR. Q-11 V-2 a-1 Revise to read:

For metal arc-welding with covered electrodes a change from one F-Number in Table Q-11.2 to any other F-Number (see notes (2) and (3) in Table Q-11.2).

PAR. Q-11 V-2 a-2 Revise to read:

For metal arc-welding with covered electrodes a change in the chemical composition of the weld deposit from one A-Number to any other A-Number in Table Q-11.3 or to a deposit analysis not listed in the table, except as permitted in note 4 of Table Q-11.2 and notes (2) and (3) of Table Q-11.3.

PAR. Q-11 V-2 b-3 Revise to read:

For gas welding a change in weld metal composition from one A-Number in Table Q-11.3 to any other A-Number. Deposit analyses not listed in Table Q-11.3 shall require separate qualification. Note 4 of Table Q-11.2 and notes (2) and (3) of Table Q-11.3 do not apply.

PAR. Q-11 V-2 c-2 Revise to read:

For inert-gas metal arc-welding a change in weld metal composition from A-Number in Table Q-11.3 to any other A-Number or to a deposit analysis not listed in Table Q-11.3. An increase in silicon content up to $1^1/_2$ per cent silicon shall not require separate qualification. Note 4 of Table Q-11.2 and notes (2) and (3) of Table Q-11.3 do not apply.

PAR. Q-22. W-1 Revise to read:

A change from the filler metal used in the performance qualification to a filler metal having a different F-Number in Table Q-22 or to a filler metal not included in Table Q-22, provided that qualification under any F-Number up to and including F4 with a nominal alloy content not exceeding 6 per cent shall qualify a welder for all lower F-Numbers. F-Number 4 having a nominal alloy content over 6 per cent, and F-Numbers 5, 6, and 7 require independent qualification.

Par. Q-23 (e) Revise to read:

Where a welder is to be qualified to weld on alloy steel material, the test specimens may be of the alloy material; or carbon steel plates and/or pipes may be substituted for the performance test with the following limitations:

(1) The total alloy content of the material for which carbon steel is substituted shall not exceed 6 per cent.

(2) The total alloy content of the electrodes (F-Numbers 1, 2, 3, and 4 of Table Q-22) used on carbon steel plates and/or pipes shall not exceed 6 per cent. Qualification of welders where the total alloy content exceeds 6 per cent shall be accomplished on material of the same grade as required in the procedure specification.

(3) When alloy steel electrodes conforming to SA-316 or SA-298 classification as permitted in (2) above are used on carbon steel plate or pipe, the test specimens are to be preheated, welded and postheated in accordance with the procedure specification for the type of electrode involved.

(4) Welders who qualify on carbon steel test plates using F4 electrodes of the SA-233 classification are also qualified to weld on alloy steel plate and/or pipe using alloy steel electrodes of a comparable or lower F-Number within the 6 per cent total alloy content limitation.

Par. Q-23 (f) Add the following as a new paragraph

When a welder is to be qualified to weld on stainless steel material, carbon steel plates or pipes may be substituted for the performance test and welded with austenitic electrodes (F-Number 5 of Table Q-22). No preheating or postheating is required.

Table Q-11-2—F-Number Grouping of Electrodes and Welding Rods for Procedure Qualification

Weld Metal Type From Table Q-11.3			Electrode Classification Number				Welding Rod Classification Number				
									Types GA and GB		
Applicable SA-Spec.	(A-No. Ref.)	(P-No. Ref.)	E-XX20 E-XX24 E-XX27 E-XX28 E-XX30	E-XX12 E-XX13 E-XX14	E-XX10 E-XX11	E-XX15 E-XX16 E-XX18	Type ER	GX-45	GX-50	GX-60	GX-65
SA-233	(A-1)	(P-1)	F1	F2	F3	F4					
SA-316	(A-2)	(P-3)	F1	F2	F3	F4					
SA-316	(A-3)	(P-4)	F1	F2	F3	F4					
SA-316	(A-4)	(P-5)	F1	F2	F3	F4					
SA-298	(A-4)	(P-5)				F4					
SA-298	(A-5)	(P-6)	Stainless Chrome Electrodes			F4					
SA-298	(A-6)	(P-7)				F4					
SA-298	(A-7)	(P-8)				F5					
SA-298	(A-8)	(P-8)	Stainless Chrome-Nickel Electrodes			F5					
SA-251	(A-1)	(P-1)						F6	F6	F6	F6
SA-251	(A-2)	(P-3)						F6	F6	F6	F6
SA-371	(A-4)	(P-5)					F7				
SA-371	(A-5)	(P-6)					F7				
SA-371	(A-6)	(P-7)					F7				
SA-371	(A-7)	(P-8)					F7				
SA-371	(A-8)	(P-8)					F7				

Note 1 E-45 series electrodes are not permitted for welding under Section IX of this Code.

Note 2 For procedure qualification a change from one F-Number to any other F-Number shall require requalification.

Note 3 Covering and filler metal types not listed above may be used but shall require separate qualification for procedure.

Note 4 Qualification of a welding procedure with an electrode up to and including A-5 (SA-298) shall also qualify the procedure for welding with any lower A-Number weld metal of Spec. SA-316 or SA-233. A change in weld metal composition to a higher A-Number within the Group A-1 to A-5 shall require requalification of the procedure. Weld metal Types A-6, A-7, and A-8 shall require separate procedure qualification. (See Par. Q-11, V-2.)

Table Q-22—F-Number Grouping of Electrodes and Welding Rods for Performance Qualification

		Electrode Classification Number				Welding Rod Classification Number				
								Types GA and GB		
Applicable SA-Spec.	(Equivalent) P-No. Ref.)	E-XX20 E-XX24 E-XX27 E-XX28 E-XX30	E-XX12 E-XX13 E-XX14	E-XX10 E-XX11	E-XX15 E-XX16 E-XX18	Type ER	GX-45	GX-50	GX-60	GX-65
SA-233	P-1	F1	F2	F3	F4					
SA-316	P-3	F1	F2	F3	F4					
SA-316	P-4	F1	F2	F3	F4					
SA-316	P-5	F1	F2	F3	F4					
SA-298	P-5				F4					
SA-298	P-6	Stainless Chrome Electrodes			F4					
SA-298	P-7				F4					
SA-298	P-8	Stainless Chrome-Nickel Electrodes			F5					
SA-251	P-1						F6	F6	F6	F6
SA-251	P-3						F6	F6	F6	F6
SA-371	P-5					F7				
SA-371	P-6					F7				
SA-371	P-7					F7				
SA-371	P-8					F7				
SA-371	P-8					F7				

Note 1 The F-Number grouping of electrodes and welding rods in this table is based essentially on their usability characteristics which fundamentally determine the ability of a welder to make satisfactory welds with a given electrode. Qualification of a welder for any given F-Number, 1 through 4, provided the nominal alloy content does not exceed 6 per cent, automatically qualifies him for any lower F-Number, but not vice versa. F-Number 4 having a nominal alloy content over 6 per cent, and F-Numbers, 5, 6, and 7, require independent qualification.

Note 2 E-45 series electrodes are not permitted for welding under Section IX of this code.

Note 3 Covering and filler metal types not listed above may be used but shall require separate qualification for performance.

Current Engineering Events, News, and Comment

E S NEWMAN
News Editor

THE ROUNDUP

M.I.T. Library Makes Current Russian Scientific Literature Available

CURRENT Russian scientific literature will soon be available in abundance to New England in the Massachusetts Institute of Technology Library. In an effort to acquire an exhaustive coverage of Iron Curtain technical data for the dual benefit of its faculty and the community at large, M.I.T. has inaugurated an extensive exchange system with Russian libraries and has accepted the role of New England depository for translations of Russian scientific and technical journals furnished by the Office of Technical Services, U. S. Department of Commerce.

Altogether O.T.S. will make available to M.I.T. approximately 10,000 translated articles and 50,000 abstracts a year for physics, biology, and chemistry. The articles are collected by O.T.S. from other government agencies, such as the Central Intelligence Agency, and made available to nine depositories throughout the country. The O.T.S. program was set up in July, 1958, when it was decided to release foreign scientific and technical material previously kept secret by government agencies. O.T.S. has functioned as a clearinghouse for research reports connected with the armed forces, Atomic Energy Commission, and other government agencies since 1945. M.I.T. will be the only depository for O.T.S. material in New England.

As early as 1955 (one and one-half years before Sputnik) the M.I.T. Library adopted the goal of eventually obtaining as adequate a coverage of Russian scientific literature as it had of German, William S. Locke, director of libraries, said. M.I.T. now receives more than 15 times as many Russian journals as it did then.

In addition to the O.T.S.-translated articles, the M.I.T. Library subscribes to journals direct from Russia. Seventy-four Russian journals and 43 from other Iron Curtain countries, including Poland, Czechoslovakia, and Yugoslavia, are regularly received at M.I.T. Nine of these are abstracting journals published by the Institute of Scientific Information, a division of the Russian Academy of Sciences, in the subjects of electronics, physics, geology, chemistry, biochemistry, mechanical engineering, mathematics, mechanics, and metallurgy.

Two years ago under a grant from the National Science Foundation the Institute undertook the project of regularly translating three important Russian electronics journals into English. Appearing in this country a few months after publication of the original in Russia, the journals are translated for M.I.T. by the Pergamon Institute of New York and London.

Supplementing the journal coverage, M.I.T. has recently inaugurated an extensive exchange system with the libraries of the universities of Moscow and Leningrad, with the Russian Institute of Scientific Information, and with eight other Russian institutions. Secor D. Browne, assistant professor of Russian, went to Russia last October on a grant from the National Science Foundation to arrange for the program, and, in November, Prof. Alexander Mikhailov from the Russian Institute of Scientific Information visited M.I.T.

The program calls for a 50-50 exchange of Russian and American current scientific books. The arrangement is particularly beneficial to M.I.T. because Russian books frequently go out of print soon after publication, and an institution not having access to advance order notification often discovers the existence of a particular book too late to obtain it on the regular market. Thus the M.I.T. Library receives many books not otherwise available.

According to Dr. Locke, Russian scientific and technical works contain almost no propaganda and their best work is on a par with that in the United States. He predicted that once the system gets well under way, M.I.T. will exchange approximately 500 books per year with Russia.

Dr. Locke added that, although a person must hold an M.I.T. library card to remove a book from library, the general public may use the library for consultation.

NOTE: Copies of O.T.S. translations and abstracts may be purchased by forwarding the order, together with check or money order payable to the Treasurer of the United States, to the U. S. Department of Commerce, Field Services, 232 Post Office Building, Boston 9, Mass.

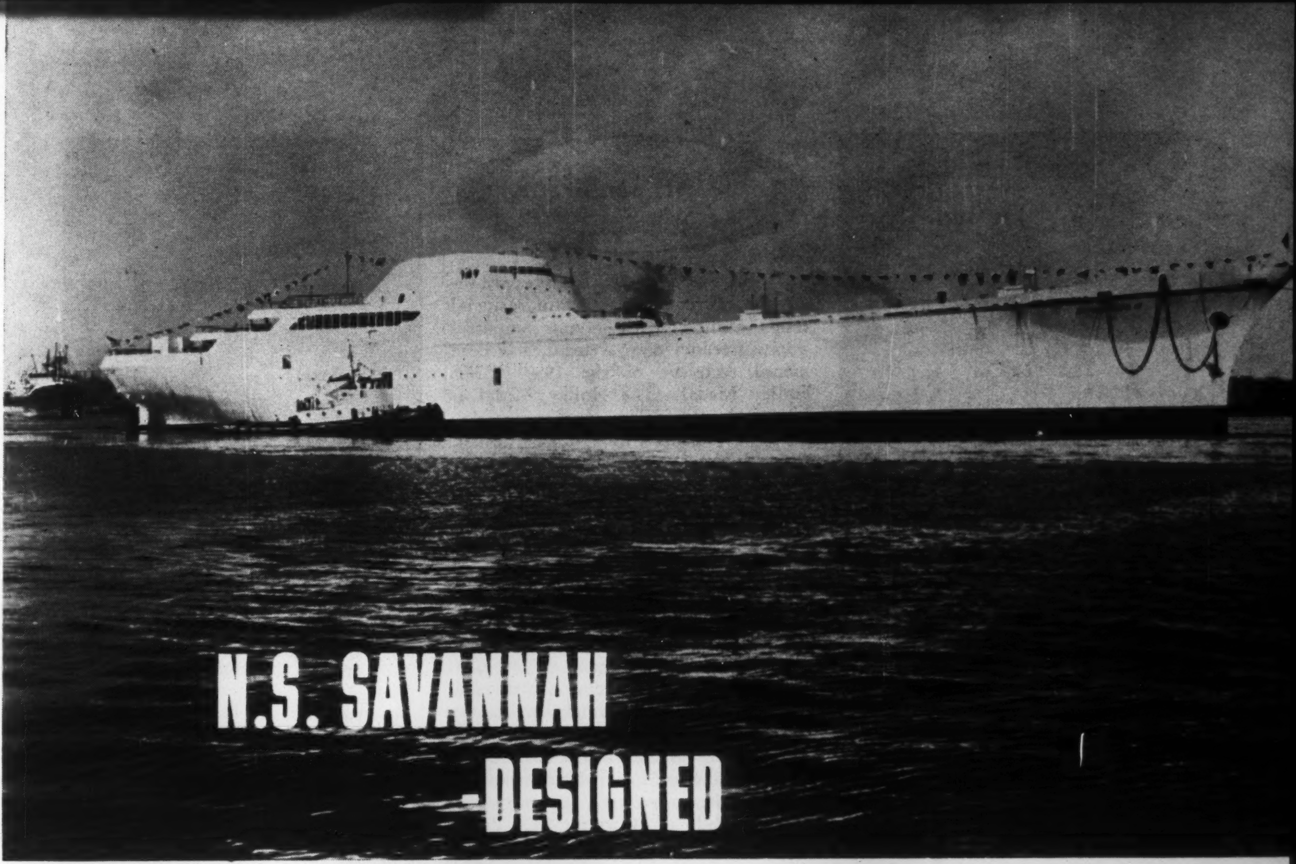
Century 21 Exposition

A WORLDS' fair, emphasizing science and its relationshipto the development of man, will receive the help of a group of leaders in American science.

Seventeen scientists from the academic world, industry, and scientific associations and journals met in Seattle, Wash., to work with exposition officials in the development of plans. The fair, which has been contemplated since 1955, is scheduled to open May, 1961, on a 70-acre site in Seattle.

The science theme of the exposition was decided upon when officials connected with the project found that science leaders were seeking a means of putting on a fair in 1961 to give a dramatic presentation of the results of the International Geophysical Year. In addition to the IGY theme, the exposition will ask and attempt to answer the question "Where is science going during the next 100 years?"

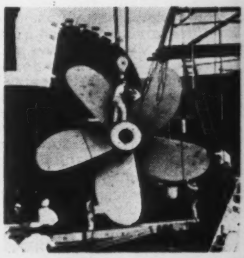
Although the basic theme will be science, the fair, which will be called Century 21 Exposition, will also mark the centennial of the University of Washington and the admission of Alaska as a state. The commercial relationship of the city of Seattle with the nations rimming the Pacific Ocean will also be stressed by exhibitions in a Pan-Pacific section. The fair is expected to be international in character, with the Soviet Union, Italy, Japan, and other nations participating.



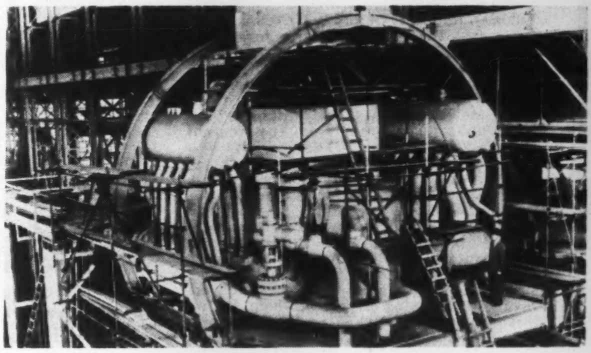
N.S. SAVANNAH -DESIGNED FOR PEACE

The launching of the **NS** (Nuclear Ship) **Savannah,** the world's first nuclear-powered passenger-cargo ship, at New York Shipbuilding Corporation, Camden, N. J., July 21, by America's First Lady, Mrs. Dwight D. Eisenhower, ushered in the atomic age in merchant marine history. (See Editorial.) The **Savannah's** characteristics: Length, 595.5 ft over-all; beam, 78-ft molded beam; draft, 29.5 ft (fully loaded), 18.5 ft (unloaded); displacement, 22,000 tons (fully loaded), 12,000 tons (unloaded); deadweight, 9990 tons, cargo capacity is 9400 deadweight tons; speed, 21 knots (normal); passengers, 60; crew, about 110; bale cubic, 746,200 cu ft cargo capacity; fuel radius, estimated 300,000 nautical miles during period of 3.5 yr (52,000 megawatt days) without refueling. Reactor: The Babcock & Wilcox reactor is advanced design pressurized-water-type with fuel elements enriched to about four per cent uranium 235; power, 74 megawatts (maximum). Engine: DeLaval steam turbine, 20,000 shp (normal), double-reduction geared to the single shaft, 22,000 shp (maximum). Vessel construction will be completed and ready for loading of nuclear fuel early in 1960. During the spring of 1960 the **Savannah** will undergo extensive testing in preparation for unrestricted operation by summer, 1950.

PROPELLER



LAUNCHING

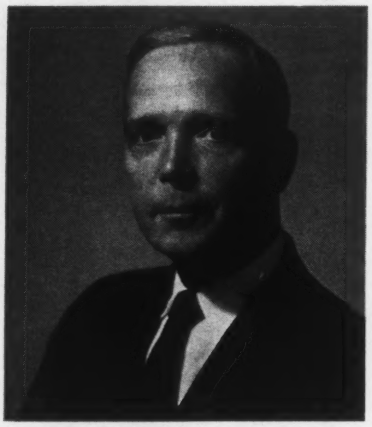


REACTOR

Wearing a white safety hat and a blue nylon waterproof coat, Queen Elizabeth II is shown leaving the Frood Mine of The International Nickel Company of Canada Ltd., in the Sudbury District of Ontario, escorted by H. S. Wingate, president of International Nickel. During her visit to the Frood Mine on July 25, the Queen descended to the 1000-ft level and witnessed a demonstration of mining operation. In her tour of Inco's mine, the Queen retraced the steps of her parents who visited there in June, 1939.

PEOPLE

Honors and Awards. Colonel Maurice J. Fletcher, designer of artificial limbs credited with giving amputees a new freedom of movement, has been named recipient of the 1959 ASME Holley Medal. The Holley Medal is bestowed only for an act of engineering genius resulting in public benefit. Colonel Fletcher, director of the Army Prosthetics Research Laboratory, Walter Reed Army Medical Center, Washington, D. C., will receive the medal at the ASME Annual Meeting to be held in Atlantic City, N. J., Nov. 29–Dec. 4.

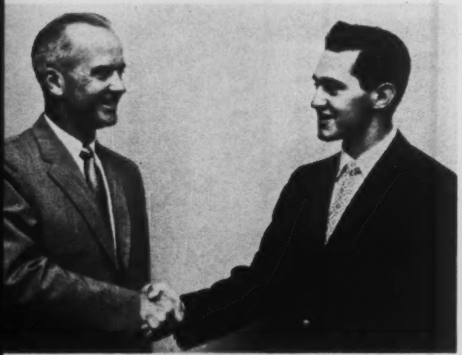


Gwilym A. Price, Affiliate ASME, chairman of the board of the Westinghouse Electric Corporation, who has been named 1959 recipient of the John Fritz Medal to be awarded during the ASME Annual Meeting at the Chalfonte-Haddon Hall, Atlantic City, N. J.

For the first time in the 58-year history of the John Fritz Medal, one of the highest honors that engineers can bestow, will go to a man with a nonengineering background, for his vision and his industrial leadership in the development of atomic power. The John Fritz Medal Board of Award recently announced that this outstanding prize of the engineering fraternity will be awarded to Gwilym A. Price, Affiliate ASME, chairman of the board of the Westinghouse Electric Corporation. The presentation of the gold medal awarded annually for notable scientific or industrial achievement will be made at the ASME Annual Meeting to be held at the Chalfonte-Haddon Hall.

The de Havilland Aircraft Company, creators of the world's first jet passenger transport, the Comet, was awarded the Elmer A. Sperry Award for "outstanding achievement in the field of transportation." The citation reads in part, "for vision, courage, and skills displayed in conceiving, developing, and producing the world's first jet-powered passenger transport aircraft." Presentation of the award will be made at a joint meeting of the Institute of Aeronautical Sciences and the Royal Aeronautical Society in New York, N. Y., later in the year. The award is sponsored by four engineering societies—The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Society of Automotive Engineers, and the Society of Naval Architects and Marine Engineers. The award is made to Sir Geoffrey de Havilland as president and inspired leader of the company that bears his name; C. C. Walker, the company's then technical director and chief engineer; and in memorium, to the late Major Frank Halford, then chairman and technical director of the de Havilland Engine Company.

H. B. Maynard, Fellow ASME, president, H. B. Maynard and Company, Inc., Pittsburgh, Pa., and a long-time committee worker for ASME, has been elected a Fellow of the International



Roger D. Casagrande, **right,** of Madison Heights, Mich., has been awarded the Detroit Edison Alex Dow Fellowship in Engineering. S. F. Leahy, **left,** Edison vice-president congratulates him. Casagrande, who is 21 years of age, married, and a senior at Wayne State University, will receive a $1500 grant, plus tuition for one year of postgraduate study leading to a master's degree in mechanical engineering. Casagrande, who is the third recipient of the Alex Dow Fellowship, is a member of Tau Beta Pi and has been active in the ASME and SAE student branches. He plans to begin his graduate work this fall at WSU where he will also serve as a graduate assistant.

Lieut. Col. Robert F. Curran, **left,** Acting Information Officer, First U. S. Army, awards a Certificate of Appreciation to John de S. Coutinho, **right,** Mem. ASME, of Grumman Aircraft Corporation, for services in connection with First Army's Rocket Safety Program for teenagers. Mr. Coutinho is chairman of the ASME Publications Committee. The program sponsored jointly by First U. S. Army, the New York University, Polytechnic Institute of Brooklyn, and industry, served to co-ordinate the activities of more than 4500 teenage rocketry groups all over the world. In existence for more than a year, the program made technical and professional guidance available to teenage rocket scientists and provided an opportunity for firing technically approved missiles built by teenagers. The award was presented following a dinner given for instructors and newsmen at the Officers Mess, Governors Island, N. Y.

Academy of Management in Athens, Greece, it was announced by Prof. Erwin H. Schell, Fellow ASME, chancellor of the academy. "Election as Fellow of the Academy," the citation reads, "is in recognition of distinguished services rendered to the science of management." The academy was formed ten years ago as a means to research management information and knowledge and to disseminate it throughout the Western World. The academy acts as a subsidiary division of the International Committee for Scientific Management of Paris, France.

William Prager, Mem. ASME, professor of applied mathematics and chairman of the Physical Sciences Council at Brown University, has been honored by election as a foreign member of the Polish Academy of Sciences. Along with his membership, Dr. Prager has been named as one of four foreign editors of the academy's journals, *The Archives of Applied Mechanics*.

Campus News. U. Amel Rothermel, Mem. ASME, has been appointed professor and head of the Department of Engineering of Queensborough Community College. In addition to Professor Rothermel's teaching experience at the College of the City of New York, he has had a varied background as an industrial consultant and as an active participant in civic and professional affairs. He is secretary of ASME Region II and a member of both Pi Tau Sigma and the American Society for Engineering Education. Queensborough Community College plans to commence its first academic semester in September, 1960. Pending determination of an adequate site in Queens, the college is temporarily located at the Board of Higher Education offices in New York City.

U. A. Rothermel, Mem. ASME, recently appointed professor and head of the Department of Engineering of Queensborough Community College.

UEC BUILDING FUND—Member Gifts Campaign Status

(As reported on August 7, 1959)

	Quota	Subscriptions	Number of Subscribers	Per Cent of Quota
ASCE	$800,000	$ 555,171.62	9,550	69.5
AIME	500,000	298,088.33	4,563	59.9
ASME	800,000	551,013.32	11,267	69.2
AIEE	900,000	775,961.06	20,715	86.2
AIChE	300,000	301,187.86	7,300	101.0
AICE	80,000	20,818.33	42	26.0
AIIndE	70,000	41,242.50	1,459	58.9
SWE	7,000	2,502.00	15	35.7
AWS	60,000	7,079.17	62	13.0
ASHRAE	...	551.50	25	...
IES	...	229.50	16	...
Other	...	6,987.91	186	...
Total		$2,560,833.10	55,200	

Appointment. Paul A. Libby, an internationally recognized authority in the field of ultra-high-speed aerodynamics, has been appointed assistant director of the Aerodynamics Laboratory of the Polytechnic Institute of Brooklyn. He assumed this post on September 1. Dr. Antonio Ferri, one of the men who developed one of the world's first jet planes, the Italian Campini, is the director of the lab in Freeport, L. I.

MEETINGS OF OTHER SOCIETIES

September 6–12

International Conference for Standards on a Common Language for Machine Searching and Translation, Tudor Arms Hotel, Cleveland, Ohio.

September 12–13

SWE, Eastern Seaboard conference, University of Bridgeport, Bridgeport, Conn.

September 13–18

ACS, annual meeting, Atlantic City, N. J.

September 18

Malleable Founders Society, industry meeting, Hotel Sheraton-Cleveland, Cleveland, Ohio.

September 21–22

Steel Founders' Society of America, fall meeting, The Homestead, Hot Springs, Va.

September 21–23

Standards Engineering Society, annual meeting, Somerset Hotel, Boston, Mass.

September 21–25

ISA, annual instrument-automation conference and exhibit, International Amphitheater, Chicago, Ill.

September 24–25

ARS, solid propellants conference, Princeton University, Princeton, N. J.

September 27–30

AIChE, national meeting, Hotel St. Paul, St. Paul, Minn.

September 28–30

IRE, national symposium on telemetering, Civic Auditorium and Whitcomb Hotel, San Francisco, Calif.

September 28–October 1

AWS, national fall meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

October 4–7

AIME, fall meeting, Memorial Auditorium, Dallas, Texas.

October 5–6

ECPD, annual meeting, Wade Park Manor, Cleveland, Ohio.

October 5–7

American Gas Association, annual convention, Hotel Claridge, Atlantic City, N. J.

October 7–9

American Vacuum Society, symposium on vacuum technology, Sheraton Hotel, Philadelphia, Pa.

October 8–10

ASTE, semi-annual convention, Chase and Park Plaza Hotels, St. Louis, Mo.

October 9–13

ASCE, Los Angeles convention, Hotel Statler, Los Angeles, Calif.

October 11–16

AIEE, fall general meeting, Hotel Morrison, Chicago, Ill.

October 11–16

ASTM, Pacific Area national meeting, Sheraton-Palace Hotel, San Francisco, Calif.

October 13–14

Society of Plastics Engineers, Inc., national technical conference, Ambassador Hotel, Los Angeles, Calif.

October 15–17

NSPE, fall meeting, Olympic Hotel, Seattle, Wash.

(*For ASME Coming Events, see page 101*)

Notes on
Society Activities
and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Plans for 1959 ASME Annual Meeting in Atlantic City, N. J., Nov. 29–Dec. 4, Shaping Up

The Philadelphia Section of The American Society of Mechanical Engineers will be Host Section to the 1959 Annual Meeting, November 29 through December 4, at the Chalfonte-Haddon Hall, Atlantic City, N. J.

The General Arrangements Committee and the Philadelphia Section, with the aid of the Meetings Committee and the co-operation of the various program-making agencies of the Society are developing a well-rounded technical and social program.

Technical Program. The 108-session technical program will be both interesting and informative. There will be one or more sessions devoted to air pollution, applied mechanics, aviation, boiler feedwater studies, corrosion and deposits, fluid meters, fuels, gas-turbine power, heat transfer, human factors, hydraulic, instruments and regulators, Junior Engineers, lubrication, machine design, maintenance, management, materials handling, mechanical pressure elements, metals engineering, nuclear engineering, petroleum, plastic flow of metals, power, power test codes, process industries, production engineering, professional practices, properties of steam, railroad, rubber and plastics, safety, solar energy, textile engineering, as well as a panel discussion by Mechanical Engineering Department Heads on education of mechanical engineers sponsored by the ASME Board on Education.

Feature Events. Following the Sunday afternoon registration period, the Philadelphia Section of the Woman's Auxiliary to the ASME will conduct an "Early Bird" Party.

Among the high lights on Monday's program is the President's Luncheon at which an address will be made by ASME President, Glenn B. Warren, and later in the afternoon the annual Business Meeting of the Society at 4:45 p.m. A "Party Night" complete with a variety show by well-established performers and dancing will provide a pleasant ending to a busy day.

Tuesday's program will feature luncheon meetings sponsored by the Fuels, Management, Metals Engineering, and Petroleum Divisions. General James M. Gavin, executive vice-president of Arthur D. Little, Inc., will deliver the Towne Lecture at the Management Luncheon. Applied Mechanics Division has scheduled a dinner at which the presentation of the Timoshenko Medal will be made to Prof. Sir Richard V. Southwell of the University of London, England, and the Hydraulic Division Dinner will feature an address on guided missile developments. The Philadelphia Woman's Auxiliary to the ASME also will hold a Tea Dance at 4:00 p.m.

Prof. C. E. Crede of California Institute of Technology will address the Machine Design Division Luncheon. The Heat-Transfer Division Luncheon will hear an address by Rear Admiral William A. Dolan, Bureau of Ships. Both of these luncheons are scheduled for Wednesday. In the evening, arrangements are being made to hold a "Theatre Night."

The Members and Students Luncheon will be held on Thursday. One of the speakers will be the winner of the Student Paper Competition sponsored by the Old Guard of the Society. The prominent social event of the meeting is the Banquet on Thursday evening which will feature an address by Dr. Marcus Long of the University of Toronto.

Friday's program will conclude with an address by D. H. McMillan of General Electric Company at the Textile Engineering Division Luncheon.

Plant Trips. An inspection of the National Aviation Facilities Experimental Center at the Atlantic City Airport will be scheduled on Tuesday morning. NAFEC is a joint project of civil and military aviation interests to do research and development on equipment for automatic flight and tlanding of airplanes.

A visit will be made on Wednesday to the Owens-Illinois Glass Company in Bridgeton, N. J., and should be of interest to engineers engaged in the manufacture and use of automatic process machinery.

View of the Chalfonte-Haddon Hall in Atlantic City, N. J., where the 1959 ASME Annual Meeting will be held November 29 through December 4. This world-famous resort makes an ideal setting for a winter meeting.

ASME COMING EVENTS

September 9–11
ASME Applied Mechanics Western Conference, Stanford University, Stanford, Calif.

September 10–12
ASME-AIChE-FPRS Wood Industries Conference, Multnomah Hotel, Portland, Ore.

September 16–17
ASME-AIEE Engineering Managment Conference, Statler Hilton Hotel, Los Angeles, Calif.

September 20–23
ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas

September 27–October 1
ASME-AIEE National Power Conference, Hotel Muehlebach, Kansas City, Mo.

October 20–22
ASME-ASLE Lubrication Conference, Hotel Sheraton-McAlpin, New York, N. Y.

October 27–29
ASME-AIME Fuels Conference, Netherland Hilton Hotel, Cincinnati, Ohio

November 4–6
ASME-IRE-AIEE-ISA National Automatic Control Conference, Sheraton Hotel, Dallas, Texas

November 8–13
ASME-ASTM-ACS International Rubber Conference, Shoreham and Park Plaza Hotels, Washington, D. C.

November 16–20
ASME Materials Handling Conference, New York Trade Show Building, New York, N. Y.

November 29–December 4
ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

March 6–9, 1960
ASME Gas Turbine Power and Hydraulic Conference, Rice Hotel, Houston, Texas

March 14–15, 1960
ASME Lubrication Symposium, Engineering Societies Building, New York, N. Y.

March 31–April 1, 1960
(Date Tentative)
ASME Textile Engineering Conference, North Carolina State College, Raleigh, N. C.

April 4–8, 1960
Nuclear Congress and Exhibit, Coliseum, New York, N. Y.

April 13–14, 1960
ASME-AIEE Railroad Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 21–22, 1960
ASME-SAM Management Conference, Statler Hilton Hotel, New York, N. Y.

April 25–26, 1960
ASME Maintenance and Plant Engineering Conference, Chase and Park Plaza Hotels, St. Louis, Mo.

April 25–29, 1960
ASME Metals Engineering Division-AWS Conference, Hotel Biltmore, Los Angeles, Calif.

May 17–19, 1960
ASME Production Engineering Conference, Milwaukee, Wis.

May 22–26, 1960
ASME Oil and Gas Power Conference and Exhibit, Muehlebach Hotel, Kansas City, Mo.

May 23–26, 1960
ASME Design Engineering Conference and Show, Statler Hilton Hotel, New York, N. Y.

June 5–9, 1960
ASME Semi-Annual Meeting, Statler Hilton Hotel, Dallas, Texas

(*For Meetings of Other Societies, see page 99*)

Note: Members wishing to prepare a paper for presentation at ASME National meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

Call for Agenda Items for 1960 RAC Meetings

The 1960 Agenda Committee extends an invitation to every member of ASME to offer suggestions and improvements in the operations of the Society. This invitation is a step in the democratic process by which the membership and the Sections impart their ideas to the Council.

Please word your proposed items so that they are clear and specific and so that there will be no misunderstanding as to intent. Also, be sure the wording is positive so that action can be taken either to "accept" or "reject" the item as worded. Accompany each item with a short statement as to why you feel that item should be approved.

All agenda items are to be submitted in accordance with the following form, *and should be sent to the Secretary of your Section not later than October 1, 1959.*

The Agenda Committee of each Section will screen these items against items previously considered by the Council, and forward the items to the National Agenda Committee not later than November 2, 1959.

If you lack the address of your Section Secretary, you may send your items, *not later than October 1, to the ASME Agenda Committee, 29 West 39th Street, New York 18, N. Y.*

ASME Agenda Item

PROPOSED BY........................... of the............... Section

Address..

Date.......................   ....
Signature

Item: It is proposed that....

Proposer's Comment:

International Heat-Transfer Conference Planned for 1961

An International Heat-Transfer Conference will be held in the United States from Aug. 28 to Sept. 1, 1961, on the campus of the University of Colorado at Boulder, according to an announcement by Dr. A. C. Mueller, Chairman of the Conference Planning Committee.

The Conference will be held under the joint sponsorship of The American Society of Mechanical Engineers, American Institute of Chemical Engineers, the Institution of Mechanical Engineers (Great Britain), and the Institution of Chemical Engineers (Great Britain). ASME and AIChE will be cohosts for the Conference. Also participating in the Conference are the American Chemical Society, American Nuclear Society, American Rocket Society, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Chemical Institute of Canada, the Engineering Institute of Canada, the Institute of the Aeronautical Sciences, and Society of Automotive Engineers.

In making the announcement, Dr.

Mueller stated that the Conference was being held for the purpose of making known new fundamental knowledge and practical developments in the field of heat transfer and to bring together the persons engaged in research, development, and application for discussion and exchange of information. This is the second such international conference, the first having been held in London, England, in September, 1951.

Papers are desired on recent original work or new applications of theory to practice. Abstracts of papers offered for the Conference should be sent to S. P. Kezios, Secretary, 1961 International Heat-Transfer Conference Committee, c/o The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y., prior to Aug. 1, 1960. More detailed information for those interested in submitting papers for this Conference will be forthcoming at a later date.

Sixth Annual ASLE-ASME Lubrication Conference Program

The Sixth Annual Conference on Lubrication jointly sponsored by the American Society of Lubrication Engineers and The American Society of Mechanical Engineers will be held at the Sheraton-McAlpin Hotel in New York, N. Y., October 20–22, 1959.

Twenty-six papers will be presented in seven sessions covering the general subjects of: Lubrication for advanced flight vehicles, metal working, rolling contact fatigue and friction, basic friction and wear, properties of lubricants, hydrodynamic bearings, and special topics.

This Conference is aimed primarily at those concerned with research and development in the fields of bearings, gears, seals, and lubrication thereof. It has become, in its short history, an important source of information for those actively working in these fields, and for others who need to learn what is happening at the forefront of the art and science of lubrication.

The registration fees, $10 for members of either society, and $15 for nonmembers, entitles one to a complete package of the 26 papers.

▶TUESDAY, OCTOBER 20

Session 1—Properties of Lubricants 9:00 a.m.

Chairman: *H. A. Hartung*, Atlantic Refining Co., Philadelphia, Pa.

Vice-Chairman: *R. B. Purdy*, Socony Mobil Oil Co., New York, N. Y.

An Analytical Investigation of Visco Elastic Effects in the Lubrication of Rolling Contact, by *R. A. Burton*, Southwest Res. Inst., San Antonio, Texas (ASLE Paper)

The Oxidation of Lubricating Oils at High Temperatures, by *A. L. Williams* and *E. A. Oberright*, Socony Mobil Oil Co., Paulsboro, N. J. (ASME Paper No. 59—LUB-8)

Meta-Linked Polyphenyl Ethers as High-Temperature Radiation-Resistant Lubricants, by *C. L. Mahoney*, *E. R. Barnum*, *W. W. Kerlin*, and *K. J. Sax*, Shell Development Co., Emeryville, Calif. (ASLE Paper)

Session 2-A—Hydrodynamic Bearings 2:00 p.m.

Chairman: *A. A. Raimondi*, Westinghouse Res. Labs, Pittsburgh, Pa.

Vice-Chairman: *O. Pinkus*, Gen. Elec. Co., West Lynn, Mass.

The Calculated Journal-Bearing Performance of Polymer Thickened Lubricants, by *H. H. Horowitz* and *F. E. Steidler*, Esso Res. and Engineering Co., Linden, N. J. (ASLE Paper)

A Sommerfeld Solution for Finite Journal Bearings With Circumferential Grooves, by *J. V. Fedor*, Tacoma Park, Md. (ASME Paper No. 59—LUB-4)

Bearing-Oil-Rings Performance, by *D. C. Lemmon*, General Elec. Co., Lynn, Mass., and *E. R. Booser*, Gen. Elec. Co., Schenectady, N. Y. (ASME Paper No. 59—LUB-5)

Torque Produced by Misalignment of Hydrodynamic Gas-Lubricated Bearings, by *J. S. Ausman*, Autonetics, Downey, Calif. (ASME Paper No. 59—LUB-3)

Session 2-B—Metalworking 2:00 p.m.

Chairman: *N. H. Cook*, M.I.T., Cambridge, Mass.
Vice-Chairman: *I-M Feng*, Ethyl Corp., Detroit, Mich.

Friction Characteristics of Sliding Surfaces Undergoing Subsurface Plastic Flow, by *M. C. Shaw*, *A. Ber*, and *P. A. Mamin*, M.I.T., Cambridge, Mass. (ASME Paper)

The Chemical Aspects of Dry-Grinding Steel With Al_2O_3 Coated Abrasives, by *E. J. Duwell* and *W. J. McDonald*, Minnesota Mining and Mfg. Co., St. Paul, Minn. (ASME Paper No. 59—LUB-6)

A Comparison of Lubricants and Coatings for Cold Extruding Titanium, by *A. M. Sabroff* and *P. D. Frost*, Battelle Memorial Inst., Columbus, Ohio (ASLE Paper)

Machining Characteristics of Leaded Steel, by *F. L. Bagley, Jr.*, and *R. Mennell*, Watertown Arsenal, Watertown, Mass. (ASME Paper)

Social Hour 5:30–7:30 p.m.

▶WEDNESDAY, OCTOBER 21

Session 3—Lubrication for Advanced Flight Vehicles 9:00 a.m.

Chairman: *E. Zeilberger*, RocketDyne, Canoga Park, Calif.
Vice-Chairman: *R. L. Johnson*, National Aeronautics and Space Agency, Cleveland, Ohio

Sliding Characteristics of Metals at High Temperatures, by *M. B. Peterson*, *J. J. Florek*, and *R. E. Lee*, Gen. Elec. Co., Schenectady, N. Y. (ASLE Paper)

Evaluation of Gear Materials Scoring at 700 F, by *E. G. Jackson*, *C. F. Muench*, and *E. H. Scott*, Gen. Elec. Co., West Lynn, Mass. (ASLE Paper)

Gear Lubrication in Inert Gas Atmospheres, by *B. B. Baber*, *C. W. Lawler*, Southwest Res. Inst., San Antonio, Texas, *H. R. Smith*, *G. A. Beane*, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, and *P. M. Kee*, Southwest Res. Inst., San Antonio, Texas (ASLE Paper)

A Research Program on the Investigation of Seal Materials for High-Temperature Application, by *R. H. Baskey*, Horizons, Inc., Cleveland, Ohio (ASLE Paper)

Session 4—Special Topics 2:00 p.m.

Chairman: *A. C. West*, California Res. Corp., Richmond, Calif.

Vice-Chairman: *E. M. Kipp*, Foote Mineral Co., Berwyn, Pa.

Hydrostatic Gas Bearings, by *J. H. Laub*, California Inst. Tech., Pasadena, Calif. (ASME Paper No. 59—LUB-1)

A General Method for Correlating Labyrinth Seal Leak-Rate Data, by *F. E. Heffner*, Gen. Motors Res. Labs., Detroit, Mich. (ASME Paper No. 59—LUB-7)

The Effect of Root Lubrication on the Damping of Cantilever Beams, by *R. V. Klint* and *R. S. Owens*, Gen. Elec. Co., Schenectady, N. Y. (ASLE Paper)

▶THURSDAY, OCTOBER 22

Session 5—Basic Friction and Wear 9:00 a.m.

Chairman: *D. Godfrey*, Calif. Res. Corp., Richmond, Calif.

Vice-Chairman: *C. Goodzeit*, Brookhaven Nat. Lab., Upton, Long Island, N. Y.

Frictional Characteristics of Flat Sliding Bearings, by *C. O. Graves*, Cincinnati Milling Machine Co., Cincinnati, Ohio (ASME Paper)

Transition Temperatures With Four-Ball Machine, by *R. S. Fein*, Texaco Res. Center, Beacon, N. Y. (ASLE Paper)

The Influence of Silicon Additions on Friction and Wear of Nickel Alloys at Temperatures to 100 F, by *D. H. Buckley* and *R. L. Johnson*, National Aeronautics and Space Agency, Cleveland, Ohio (ASLE Paper)

Distribution of an EP Film on Wear Surfaces, by *R. C. Wiquist*, *S. B. Twiss*, and *E. H. Loeser*, Chrysler Corp., Detroit, Mich. (ASLE Paper)

Session 6—Rolling Contact Fatigue and Friction 2:00 p.m.

Chairman: *T. W. Morrison*, SKF Industries, Philadelphia, Pa.

Vice-Chairman: *E. G. Jackson*, Gen. Elec. Co., West Lynn, Mass.

Effect of Hardness, Grain Size, and Surface Finish on Rolling Contact Fatigue Life of M-50 Bearing Steel, by *R. A. Baughman*, Gen. Elec. Co., Evandale, Ohio (ASME Paper)

The Importance of Spinning Friction in Thrust-Carrying Ball Bearings, by *G. S. Reichenbach*, M.I.T., Cambridge, Mass. (ASME Paper No. 59—LUB-9)

The Effect of Ball-Bearing Steel Structure on Rolling Friction and Contact Plastic Deformation, by *R. C. Drutowski* and *E. B. Mikus*, Gen. Motors Corp., Warren, Mich. (ASME Paper No. 59—LUB-2)

A General Theory for Elastically Constrained Ball and Radial Roller Bearings Under Arbitrary Load and Speed Conditions, by *A. B. Jones*, Fafnir Bearing Co., New Britain, Conn. (ASME Paper No. 59—Lub-10)

Papers by Mail

ASLE

Copies of ASLE papers may be ordered by writing to ASLE, 5 North Wabash Avenue, Chicago 2, Ill. Please order by paper number.

ASME

Only numbered ASME papers in this program are available in separate copy form until Sept. 1, 1960. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 40 cents to members of ASME, 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten are $3 to members; $6 to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the Conference.

AIME-ASME Joint Solid Fuels Conference in Cincinnati, October 28-29

Long-range appraisal of mechanized mining will be among the themes discussed by leading authorities at the Joint Solid Fuels Conference to be held Oct. 27–29, 1959, in the Netherland-Hilton Hotel, Cincinnati, Ohio. Sponsors will be the Coal Division of the Society of Mining Engineers of AIME and the Fuels Division of The American Society of Mechanical Engineers. The Society of Mining Engineers is a constituent organization of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

The two sponsors, AIME and ASME, hold this conference jointly each year, alternating as hosts. AIME is host this year.

W. T. Reid, ASME, assistant technical director, Battelle Memorial Institute, Columbus, Ohio, is chairman of the Joint Planning Committee. Other members of this Committee are: M. D. Engle, ASME, mechanical engineer, Penn Power & Light Company, Allentown, Pa.; Henry F. Hebley, AIME, consultant, Pittsburgh, Pa.; H. Vaughan Mansfield, ASME, chief engineer, engineering department, Peabody Coal Company, St. Louis; H. Eugene Mauck, AIME, general superintendent, Olga Coal Company, Coalwood, W. Va.; Julian E. Tobey, AIME, president, Appalachian Coals, Inc., Cincinnati, Ohio; Fred R. Toothman, AIME, mining engineer, Chesapeake & Ohio Railway, Huntington, W. Va.

Mr. Tobey, Fellow ASME, is general chairman of the conference. Mr. Mauck is chairman of the Program Committee of the Society of Mining Engineers. ASME Program Chairman is L. P. Copain, Riley Stoker Corporation, Worcester, Mass.

Jerome W. Woomer, consultant, Pittsburgh, is president of the Society of Mining Engineers. Chairman of ASME's Fuels Division is Charles Kottcamp, Gulf Research and Development Company, Pittsburgh.

Included among the topics to be discussed are: "Modern Methods of Firing Solid Fuels in Industrial Plants"; "Survey of Carbonizing Properties of American Coals"; "Factors to Be Considered in the Use and Application of Industrial Coals"; "Use of Bench Scale Tests to Predict Combustion Performance of Coals"; "Preparation of Coal for Industrial Consumption"; and "Preparation of Coal for the Export Market."

▶WEDNESDAY, OCTOBER 28

Registration **8:30 a.m.**

Technical Session 1 **9:30 a.m.**

Co-Chairmen: *H. E. Hauck*, AIME, general superintendent, Olga Coal Co., Coalwood, W. Va.
W. E. Butler, ASME, district sales manager, The Babcock & Wilcox Co., Cincinnati, Ohio.

Volume Distribution of Coal, by *C. P. Blair*, N&W RR, Roanoke, Va.

Design of a Modern Coal Mine, by *G. W. McCaa*, Hanna Coal Co., Cadiz, Ohio

Preparation of Coal for the Export Market, by *M. P. Corriveau*, Clinchfield Coal Co., Dante, Va.

Luncheon **12:00 Noon**

Presider: *W. C. Bissmeyer*, chairman, ASME Cincinnati Section

Speaker: *A. A. Potter*, president, B.C.R., Columbus, Ohio

Subject: **Investment in Human Betterment**

Technical Session 2 **2:00 p.m.**

Co-Chairmen: *H. B. Lammers*, ASME, chief engineer, Appalachian Coal, Inc., Cincinnati, Ohio
G. G. Ritchie, AIME, Coal Traffic Manager, engineering, C&O RR, Richmond, Va.

Ash-Flow Characteristics, by *W. L. Sage* and *J. B. McIlroy*, The Babcock and Wilcox Co., Alliance, Ohio (Paper No. 59—FU-4)

Fireside Corrosion of Superheater and Reheater Tubing, by *G. A. Rice*, Electric Energy, Inc., St. Louis, Mo., and *James Jonakin*, Combustion Engineering Co., Inc., Kreisinger Development Lab., Chattanooga, Tenn.

Coal Evaluation for the Beckjord Station, by *J. F. Cotter*, Combustion Engineering Co., Inc., New York, N. Y.

Banquet **7:00 p.m.**

Presider: *J. E. Tobey*, general chairman of the Solid Fuels Conference, president, Appalachian Coals, Cincinnati, Ohio

Speaker: *Ernest S. Fields*, president, The Cincinnati Gas and Electric Company.

Subject: **The Ohio River and Power Developments**

The Percy Nichols Award will be presented at the banquet.

▶THURSDAY, OCTOBER 29

Registration **8:30 a.m.**

Technical Session 3 **9:00 a.m.**

Co-Chairmen: *C. F. Hardy*, AIME, managing director, Bituminous Coal Inst., Washington, D. C.
John Sinica, ASME, district sales manager, Combustion Engineering Co., Inc., Cincinnati, Ohio.

Preparation of Coal for Industrial Consumption, by *A. S. Maynard*, Truax-Traer Coal Co., Ceredo, W. Va.

A Long-Range Appraisal of Mechanical Mining, by *A. L. Barrett*, Joy Mfg. Co.

Preparation of Coal for Utility Use, by *M. W. Mellor*, McNally-Pittsburg Mfg. Co., Pittsburg, Kan.

Luncheon **12:00 Noon**

Presider: *R. E. Salvati*, president, Island Creek Coal Co.

Speaker: *F. W. Giesil*, business manager, *The Cincinnati Post-Times Star*

Subject: **Black Africa**

Technical Session 4 **2:00 p.m.**

Co-Chairmen: *E. J. Martin*, ASME, associate chief engineer, Procter & Gamble Co., Cincinnati, Ohio
James Garvey, AIME, director of research, Bituminous Coal Research, Columbus, Ohio

Use of Bench-Scale Tests to Predict Combustion Performance of Coals, by *E. W. Zawadski*, chemist, Pittsburgh, Pa., and *Felix deBreuil*, Bituminous Coal Research, Columbus, Ohio (Paper No. 59—FU-3)

Survey of Carbonizing Properties of American Coals, by *D. E. Wolfson*, Coal Carbonizing Section, U. S. Bureau of Mines, Pittsburgh, Pa. (Paper No. 59—FU-1)

Factors to Be Considered in the Use and Application of Industrial Coals, by *U. B. Yeager*, Island Creek Coal Sales Co., Huntington, W. Va. (Paper No. 59—FU-2)

ASME Elects Thirteen to Grade of Fellow Member

The American Society of Mechanical Engineers has honored 13 of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a Member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or Members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

David B. Rossheim

David B. Rossheim, chief mechanical engineer, The M. W. Kellogg Company, New York, N. Y., has achieved national and international recognition in the field of pressure and heat-exchange equipment design and construction with many years of service on the ASME Boiler and Pressure Vessel Committee and its many Subcommittees, and on the Code for Pressure Piping Committee (ASA B31.1). Jointly with the late Dr. Jacobus, and H. Leroy Whitney, he pioneered criteria for high-temperature design and prepared the first comprehensive allowable stress tables; in the early twenties he interested Commander Saunders (later Admiral), and the late Dr. Windinburg of the Navy Model Basin, then at Anacostia, in rationalizing and simplifying external-pressure design, and provided the first graph of the complex Von Mises formula leading to its simplification as a basis for the present Code charts. He collaborated with Professor Waters and Messrs. Williams and Wesstrom in providing the first rational basis for bolted flange design, an early application of organized solution to achieve economic production engineering of complex problems. With R. K. Hopkins and H. S. Blumberg of the same company, he established the initial approach for low-temperature vessel design and the attendant advantages of carbon steels made to fine grain practice, low carbon content, and stress relief. As the direct result of a joint paper with A. R. C. Markl, practical rules for piping-expansion flexibility were incorporated into the Code for Pressure Piping (ASA B31.1), which first recognized "self-springing" and the fatigue character of thermal stress. To implement the routinized solution of piping-system thermal expansion design, he supervised the first edition of the M. W. Kellogg Company, "Design of Piping Systems," in 1940, followed in 1956 by a second edition which extended the Kellogg Method to include simultaneous solution of external loading (weight, wind, and so on) with thermal effects, and further presented the first broad treatment of piping structural design, which is recognized as the basic reference for this field of engineering. A series of papers by Mr. Rossheim in collaboration with J. J. Murphy and C. R. Soderberg, Jr., of The M. W. Kellogg Company have been devoted to the rationalization of pressure equipment for improved safety and economics through a balanced association of requirements for design, materials, fabrication, and inspection, which has led to a current reappraisal of the Code Basis. Within the Kellogg Company, Mr. Rossheim has played a major role in establishing design in the field of petroleum-refinery engineering and the art of welding. For six years he successfully administered his firm's activities in the guided missile and rocket-development fields. Mr. Rossheim holds a number of patents. He has authored numerous papers on pressure and heat-exchange equipment and process-plant equipment, including several papers published in the *Transactions of the ASME;* Pressure Vessels and Boilers, Chapter 51, "American Welding Society Handbook," and the afore-mentioned book, "Design of Piping Systems." He is a member of several professional and technical societies, including ASCE, ASTM, AWS, ASM, ANS, and API.

James B. Jones

James Bernard Jones is professor and head of the department of mechanical engineering at Virginia Polytechnic Institute, Blacksburg, Va. Professor Jones has been on the faculty at V.P.I. since 1921. In 1932 he attained the rank of associate professor and was made head of the department of mechanical engineering. He was promoted to the rank of full professor in 1937. When he took his current post the department numbered 290 students and five teachers. During his tenure the department has grown to 750 students and 25 teachers. In 1952 the department moved into its own building, the completion of which was the fulfillment of a vision sold to the State of Virginia by Professor Jones. The building, valued at $1,250,000, had its design and construction constantly supervised by Professor Jones; and is one of the most outstanding engineering classroom and laboratory buildings in this country. In 1956 he was appointed to a four-year term as a member of the Blacksburg-Christianburg V.P.I. Water Authority. In the work of this Commission, he has contributed his time and talents to determine improvements in equipment and to plan the constantly increasing capacity of the water supply as required for a rapidly growing community. Professor Jones has served the Society on the national and the local level. He has served as chairman of the Virginia Section, as honorary chairman of the V.P.I. Student Section, and was chairman of the Student Section Committee for Region IV. He served as chairman of the Local Sections Conference in 1941 and was secretary of the National Delegates Conference in 1942; member of National Nominating Committee in 1945 and 1947, chairman in 1947; secretary, 1950–1954; Vice-President, 1954–1956, ASME Region IV. For his efforts in advancing the aims and ideals of ASME in the southeastern region, he received the 75th Anniversary Medal of the ASME. He is a member of Tau Beta Pi, Pi Tau Sigma, Sigma Mu Sigma, Omicron Delta Kappa, Sigma Delta Psi, and Alpha Phi Omega, honorary fraternities. He is also a member of ASEE and NSPE. He is a registered professional engineer in the State of Virginia.

F. S. G. Williams

Frank Sargood Giles Williams, engineering consultant and director of procurement, Taylor Forge & Pipe Works, Inc., Chicago, Ill., has contributed greatly to the advancement of the engineering profession through research and publication of articles on piping and flange design, and by detail and administrative work on numerous national Code committees. Evidence of his achievement is the fact that at the time of his appointment to the Main Committee of the ASME Boiler and Pressure Vessel Committee, he was the youngest man on the committee by eleven years. He has served this Committee continuously since 1943. In 1957 he was vice-chairman of its Main Committee and chairman of its Executive Committee. He has been chairman also of the Subcommittee on Openings and Bolted Connections and the Special Committee on Nuclear Power; and is a member of the Subgroup on Ferritic Castings and Forgings and Subcommittee on Special Design. From 1950 to 1955 he was a member of the Board on Codes and Standards, and in 1955 he served on the ASME National Nominating Committee. In 1948, Mr. Williams assumed the chairmanship of the Code for Pressure Piping Committee and, under his direction, the activity was reorganized. The work of the committee is such that the code has been expanded from a single volume to seven volumes, three of which have already been published. His work, in 1933, with Dr. Jacobus, H. Leroy Whitney, and D. B. Wesstrom in the development of an orderly procedure for flange design for the ASME Boiler Code Committee has proved an invaluable guide. The work led to five years of active engineering effort in development of the modifications of Taylor-Waters formulas. Mr. Williams is responsible for the publication of the complete derivation of this work in a privately published document, "General Formulas for Bolted Connections." This and numerous other signal accomplishments attest to Mr. Williams' talent for direction and leadership of engineering activities. In addition to his work with ASME, he is active on many ASA, ASTM, and AWS committees. He has been a member of the U. S. Navy Advisory Committee on High Pressure Temperature Pipe Flanges; and the American Bureau of Shipping Interim Committee on Ratings. He has contributed numerous articles to technical journals.

Harry F. Vickers

Harry F. Vickers, who has been president of Sperry Rand Corporation since it was formed in 1955 by the merger of the Sperry Corporation and Remington Rand, Inc., has a long record of engineering achievement and industrial administration. His work in naval ordnance during the 1930's led to completely new systems of hydraulically operated ammunition handling and naval-gun operation. For his contributions to World War II naval efficiency, he was commended by Admiral Harold Stark, former chief of the U. S. Navy Bureau of Ordnance. He also contributed extensively to hydraulic-control systems used on B-17, B-24, and B-29 bombers. He pioneered the development of hydraulic power steering for automotive, construction, and materials-handling vehicles.

Mr. Vickers interrupted his education to serve with the U. S. Army Signal Corps in France during World War I where he was in charge of construction of what was then a powerful radio transmitter which maintained daily contact with the United States. The firm, Vickers, Inc., which he formed in 1921, became the largest of its kind in the nation and eventually merged with the Sperry Corporation of which Mr. Vickers became successively senior vice-president and president. Mr. Vickers, in 1956, received the ASME Medal for "pioneering in industrial oil hydraulics and for notable accomplishments in business leadership." In 1956 the University of Southern California awarded him the honorary degree of doctor of science. He holds over 100 patents on hydraulic equipment and its applications to machine tools, industrial and oil-field equipment, and ordnance; he also holds a multiengine pilot's license. He is a member also of the AOA, IAS, SAE, SNAME, the Engineering Society of Detroit, the National Aeronautic Association, and the National Security Industrial Association.

Theodore Baumeister

Theodore Baumeister, Stevens Professor of Mechanical Engineering at Columbia University, combines the rare faculty of teaching and practice to a degree that puts his engineering services in great demand. Since 1922, he has progressed through all the faculty ranks at Columbia and in 1950 he was appointed to his current post. As a consulting engineer, specializing in the field of power and power machinery, more recently in nuclear power, he has been associated with many of the designs of the nation's most important steam stations and several atomic-power projects. His clients and employers include, or have included, General Public Utilities Corporation, Central Hudson Gas and Electric Corporation, South Carolina Electric and Gas Company, The Babcock & Wilcox Company, American Gas and Electric System, E. I. duPont de Nemours and Company, Brookhaven National Laboratory, Worthington Corporation, Stevens and Wood, Inc., Thomas E. Murray, Inc., Duke Power Company, and Ingersoll-Rand Company. He served as consultant to the City of New York on the recent sale of the Transit Power Plants to the Consolidated Edison Company, and he has been invited to serve as an advisor to the Governor's Commission on Power Resources of New York. He is the editor-in-chief of "Marks' Mechanical Engineers' Handbook," Sixth Edition; and has contributed power sections to "Perry's Chemical Engineers' Handbook," "Knowlton's Standard Handbook for Electrical Engineers," the "Encyclopedia Britannica," and many others. He is a consulting editor for McGraw-Hill's "Encyclopedia of Science and Technology." Professor Baumeister's services to the Society include: Power Division Executive Committee, secretary, 1940, chairman, 1943; Power Test Codes Committee; Process Industries Division Executive Committee; Engineering Societies Library Board; Metropolitan Section chairman; and many others. Among the professional societies to which he belongs are: I. Mech. E., AAAS, ANS, ASEE, AAUP, New York Academy of Sciences, and Newcomen. He is also a member of Sigma Xi and Tau Beta Pi. He is a registered professional engineer in the state of New York as well as being a chartered mechanical engineer in Great Britain.

James H. Harlow

James H. Harlow, chief mechanical engineer, Philadelphia Electric Company, has used his knowledge in both mechanical and electrical engineering to develop power-plant designs that are outstanding in the industry. With Philadelphia Electric since 1923, he has been responsible for engineering, design, construction, and preliminary operation work on the utility's major stations. Since the War, additions aggregating over 1,500,000 kw have been installed at six locations. Now under construction is the Eddystone Station with a rating of 650,000 kw. Eddystone is a supercritical plant incorporating the most advanced steam-pressure and temperature conditions yet attempted in a steam plant. In addition to power-plant design, he has been responsible for a broad range of engineering work of the type required by a large electric utility. He has been active on many working committees of the ASME. He has been a member and chairman, Executive Committee, Philadelphia Section. On the national level he has served as a member and chairman, Board on Membership; member, National Nominating Committee, Boiler Code Committee and Subcommittees; Special Research Committee on Furnace Performance Factors; Research Committee on Low-Temperature Flue-Gas Corrosion and Deposits; and was ASME representative on ECPD Recognition Committee. His published works include numerous articles which have appeared in the *Transactions of the ASME*, as well as in other technical journals. He is a Fellow of the AIEE, and is a member of ASTM, the Engineers' Club of Philadelphia, The Franklin Institute, and Tau Beta Pi. Mr. Harlow is a registered professional engineer in three states: Maryland, New Jersey, and Pennsylvania.

James A. Johnston

James Ambler Johnston is senior member of the firm of Carneal and Johnston, Architects and Engineers, Richmond, Va. In his career of more than 50 years, he has manifested qualities of responsibility, initiative, ingenuity, perseverance, and, most important of all, technical proficiency. He has been associated with the design and execution of many of the larger buildings in the Richmond area. The list of buildings ascribed to Mr. Johnston is long, and includes churches, manufacturing plants, office buildings, and schools, colleges, and institutional buildings in various parts of the State of Virginia. He holds patents pertaining to locking devices for cell-block doors in penal institutions. A tireless and devoted worker in the development of engineers and engineering activities, Mr. Johnston has, through personal support and encouragement of his fellow engineers, contributed much to ASME and other professional and technical societies. He has been active in civic affairs serving on a number of technical boards and commissions for the City of Richmond and the State of Virginia. He assisted with the revision and adoption of the Building Code of the City of Richmond. Mr. Johnston has also been active in city planning and municipal affairs. He has been chairman of a board making traffic and off-the-street parking studies for the city, and also has made more than a score of studies for the city on various other matters in the public interest. He is a registered professional, mechanical, and architectural engineer in the State of Virginia. He is a member as well of NSPE, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, the American Institute of Architects, the Newcomen Society, Tau Beta Pi, Phi Kappa Phi, and Omicron Delta Kappa. In addition to his professional attributes, Mr. Johnston is a frequent lecturer on the Civil War area about Richmond.

William M. Keller

William McKinley Keller, vice-president, research, Association of American Railroads, Chicago, Ill., is recognized for his contributions to the art of railroad mechanical engineering. From 1922 to 1952, he was associated with the Pennsylvania Railroad. Beginning with the design of shop tools for locomotive repairs, he progressed through inspection and testing positions to work on special engineering problems, and locomotive and car design. He had been in charge of the following new car designs: Coach, dining, kitchen-dormitory, observation, and club cars; and 50-ft and 60-ft lightweight box cars. In addition, a new air-conditioning system was designed and built under his supervision. He was in charge of research in the Pennsylvania mechanical-engineering department and a number of devices were developed under his direction. A sampling of the patents which he holds gives some indication of his accomplishments—fluid-cooled journal bearing, cover for gondola cars, wheel slide-control device, belt-guard for railway generators, and numerous others. With AAR, he has had direct charge of all research pertaining to engineering, mechanical details, container and loading, and sanitation. More than 100 scientists and technicians come under his direction. Mr. Keller also personally reviews and edits all technical reports which are made to AAR technical committees. He is the author of many papers on the subject of railway mechanical engineering. He is a member also of ASTM and The Franklin Institute.

Granger Davenport

Granger Davenport is chief engineer with Gould & Eberhardt Division of Norton Company, Irvington, N. J. He has been with the firm since 1923, and has earned a reputation in the field of design and production of machine tools and of gears. He has been equally active in the area of standardization. For five years, Mr. Davenport was active on the ASME Standardization Committee, the last year as chairman. He served also on the ASME Board on Codes and Standards for a three-year term. For years he served as chairman of Subcommittee on Inspection, B6, and is presently chairman of Subcommittee on Gear Nomenclature, also B6. He was ASME representative on the ASA Standards Council; and in 1956 was the recipient of a service scroll in recognition of his work in the development of American Standards. He is the author of several papers on the subject published in *Industrial Standardization* and the *Tool and Die Journal*, and has written handbook sections in technical books dealing with the gearing industry. He has been a guest lecturer at Illinois Institute of Technology. Mr. Davenport is a member also of ASM and American Society of Naval Engineers. Since 1935 he has been his company's voting representative in the American Gear Manufacturers Association, and this year he was the recipient of the Edward P. Connell Award, established by the Falk Corporation in collaboration with AGMA, for outstanding service to the gear industry. He is a registered professional engineer in New Jersey and New York. He is inventor or coinventor of 14 patents dealing with machine tools.

Charles L. Pope

Charles Linder Pope, lubrication engineer, Eastman Kodak Company, Rochester, N. Y., is recognized for his contributions in the field of lubrication. When Mr. Pope joined Eastman in 1930, its lubrication program was almost nonexistent. Today, as a result of his efforts, the firm's lubrication program is one of the most thorough and most effective of its kind. The program was instituted by Mr. Pope and his staff, working without established precedent, gathering original data, testing, and designing test equipment. His outstanding work on lubrication was recognized by the ASLE which presented him with the first Alfred E. Hunt Memorial Medal. Testimony of his work may be found in the technical literature in which he has had published many papers. He is coauthor of a textbook, "Lubrication of Industrial and Marine Machine," John Wiley & Sons; and is coauthor also of the section on antifriction bearings in "Marks' Mechanical Engineers' Handbook," Sixth Edition. He has served the Society as chairman of the Applications Subcommittee of the Petroleum Committee, 1947–1948. He is ASME representative on ASA Sectional Committee Z-11 on petroleum products. He is a member of ASLE and 1949–1950 served as its president; and is a member also of ASTM for which he does much committee work.

William F. Uhl

William Frank Uhl, chairman of the board, Chas. T. Main, Inc., and senior partner, Uhl, Hall & Rich, Boston, Mass., is one of the foremost hydraulic engineers in the U. S. and is widely acknowledged in foreign countries. His professional career, principally in connection with hydroelectric power, has been marked by work with 34 new plants, 28 redevelopments, and he has acted as consultant on 52 others. He has been engaged on many projects in Africa, Turkey, South America, and Canada. Mr. Uhl joined Charles T. Main in 1909, became president of Chas. T. Main, Inc. in 1939, and in 1957 was made chairman of the board. At the present time, through Uhl, Hall & Rich, he is engaged in the design and supervision of construction of two large hydroelectric projects for the Power Authority of the State of New York—Barnhart Island on the St. Lawrence River and Lewiston on the Niagara River. Together the plants have a total normal capacity of 3-million kw in the U. S. Mr. Uhl is a member of the Tennessee Valley Authority Board of Consultants, and he formerly acted as special consultant on a number of U. S. Engineer flood-control projects. He has been a member of the Engineers Joint Council National Water Policy Panel; is a member of the New England Section for Hydraulic Power of the Edison Electric Institute; vice-chairman of the U. S. Committee of the International Commission on Large Dams. Mr. Uhl is the author of a number of papers on the subject of hydroelectric power, flood control, and other subjects. He is a member also of ASCE, AIEE, NSPE, The American Geophysical Union, the Newcomen Society, and is an Honorary Member of B.S.C.E. Tufts University and Michigan State University have each conferred upon him the honorary degree of doctor of engineering. He is a registered professional engineer in 33 states. In 1958, ASCE awarded him the James Rickey Medal and in 1955 he received the Alumni Award for Distinguished Service from his Alma Mater, Michigan State University.

Frank D. Carvin

Frank Dana Carvin is a distinguished educator. He retired in 1958 from his post as director of mechanical engineering at Illinois Institute of Technology, an office which he held since 1948. Prior to that time, he had been professor and head of the department of mechanical engineering at Newark College of Engineering-1934–1948. In his last two years at NCE, he served also as chairman of the Graduate Division. From 1924 to 1934, he was on the faculty at Polytechnic Institute of Brooklyn. His career in education began at the University of Pennsylvania. Concurrently with his teaching activities, Dr. Carvin has engaged in consulting work which he continues to do. He served in World War I with the U. S. Army Signal Corps. Dr. Carvin has published a number of articles in trade magazines as well as in scholarly journals. He has served the ASME, as he has served a number of other professional and civic organizations, untiringly. A member of the Executive Committee of the Metropolitan Section from 1939–1943, he served as its chairman in 1941. From 1953 to 1956, he was a member of the Executive Committee of the Chicago Section. He was a member of the Industrial Salvage Committee of the War Production Board, the War Production Board Clinic, and

ASME representative to the Council of AAAS. He has been equally active in ASEE and AAAS, and is a fellow of the latter society as well as secretary of Section M—Engineering. He is a member also of Sigma Tau, Tau Beta Pi, and Pi Tau Sigma. He is a registered professional engineer in the State of Illinois, New York, and New Jersey.

J. B. Thomas

Julian Baldwin Thomas is president and general manager of Texas Electric Service Company, Fort Worth, Texas. His career with electric utilities began in 1911 with the Texas Power and Light Company. There, he was responsible for design and construction costing $50 million, comprising 70,000 kw of electric-generating capacity, and more than 4000 miles of electric-transmission lines with pertinent substations, buildings, and such. He joined Texas Electric in 1930, and, within 11 years, assumed the office which he now holds. Mr. Thomas was among the first to recognize the advantages of outdoor-type electric-generating stations. He also directed the design and installation of centralized remote control of all the functions of a modern power-plant system. In arid West Texas a dwindling water supply had been an acute problem. Under the direction of Mr. Thomas, a water-supply district and supply system was devised for three cities in the utility's service area. In addition to this water-supply-development program, the utility, guided by Mr. Thomas, is exploring electrodialysis to determine if the vast quantity of brackish and highly mineralized water in West Texas can be made potable. Equipment, currently in use, is producing 86,000 gal of water per day by this method for use in power-plant boilers.

Mr. Thomas's activities in water development and conservation have been recognized and honored by the West Texas Chamber of Commerce, the Fort Worth Chamber of Commerce, and the Texas Society of Professional Engineers. Governor Shivers of Texas in 1952 named Mr. Thomas chairman of the Governor's Committee on Water Conservation. He has been active also in the formation of the Texas Atomic Energy Research Foundation and was elected its first president. Mr. Thomas is a trustee of Texas A&M College Research Foundation. He holds a number of patents for machinery equipment. He is a fellow also of AIEE. He has served the Society as chairman of the Prime Movers Committee Award and is a member of the Westinghouse Medal Award Committee. He is a registered professional engineer in the State of Texas.

Applied Mechanics Conference—Availability List

The papers in this list are available in separate copy form until April 1, 1960. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $3 to members; $6 to nonmembers. (See Mechanical Engineering, August, 1959, pp. 114-115.)

59—APM-1 Analysis of Plane Stress in Polar Co-Ordinates and With Varying Thickness, by H. D. Conway

59—APM-2 A Theory of Oil Whip, by Yukio Hori

59—APM-3 Displacements and Stresses of a Laterally Loaded Semicircular Plate With Clamped Edges, by W. H. Jurney

59—APM-4 Extensional Vibrations of Elastic Plates, by R. D. Mindlin and M. A. Medick

59—APM-5 On Finite Bending of Pressurized Tubes, by Eric Reissner

59—APM-6 Creep of Thick-Walled Tubes Under Internal Pressure Considering Large Strains, by F. P. J. Rimrott

59—APM-7 Thermal Stresses in Moderately Thick Elastic Plates, by B. E. Gatewood

59—APM-8 The Frequency of Flexural Vibration of Rectangular Orthotropic Plates With Clamped or Supported Edges, by R. F. S. Hearmon

59—APM-9 On Inertia Effects in a Transient Thermoelastic Problem, by Eli Sternberg and J. G. Chakravorty

59—APM-10 On Supersonic Wind Tunnels With Low Free-Stream Disturbances, by M. V. Morkovin

59—APM-11 Triaxial Tension at the Head of a Rapidly Running Crack in a Plate, by J. M. Frankland

59—APM-12 On Critical Speeds of a Shaft Supported by a Ball Bearing, by Toshio Yamamoto

59—APM-13 Symmetric Vortex Separation on Circular Cylinders and Cones, by A. E. Bryson

59—APM-14 The Drag on Spheres and Cylinders in a Stream of Dust-Laden Air, by Thomas Gillespie and A. W. Gunter

59—APM-15 Incremental Stress-Strain Law Applied to Work-Hardening Plastic Materials, by Chintsun Hwang

59—APM-16 Carrying Capacity of Elastic-Plastic Shells With Various End Conditions Under Hydrostatic Compression, by Burton Paul

59—APM-17 The Stress Distribution in a Semi-Infinite Strip Subjected to a Concentrated Load, by P. S. Theocaris

59—APM-18 Upper and Lower Bounds for Special Eigenvalues, by F. C. Appl and C. F. Zorowski

59—APM-19 Density Variation Effects in Stepped-Thrust Bearings, by C. F. Kettleborough

59—APM-20 On Invariant Perforation in an Infinite Strip, by Chih-Bing Ling

59—APM-21 On the Instability and Folding Deformation of a Layered Viscoelastic Medium in Compression, by M. A. Biot

59—APM-22 Vibration of Beam-Mass Systems With Time-Dependent Boundary Conditions, by T. C. Yen and S. Kao

59—APM-23 A New Theory of Elastic Sandwich Plates—One-Dimensional Case, by Yi-Yuan Yu

59—APM-24 Piping Flexibility Analysis by Stiffness Matrix, by L. H. Chen

59—APM-25 The Stress Function of a Radial Strain, by F. Goded

59—APM-26 The Determination of Safe Loads of Beams Subjected to Combined Twisting and Biaxial Bending Moments, by P. G. Hodge, Jr., and R. Sankaranarayanan

59—APM-27 Note on a Thermoelastic Problem for a Transversely Isotropic Hollow Sphere Embedded in an Elastic Medium, by J. Nowinski

59—APM-28 Viscous Flow Through Tubes of Multiply Connected Cross Sections, by F. A. Gaydon and H. Nuttall

59—APM-29 Analysis of a Nonlinear Mechanical System With Three Degrees of Freedom, by S. A. Hovanessian

59—APM-30 On the Accuracy of Some Shell Solutions, by G. D. Galletly and J. R. M. Radok

ASME Woman's Auxiliary Receives Biography

Following the 1958 ASME Annual Meeting, James H. Sams, ASME Vice-President of Region IV, 1956–1958, and dean of the School of Engineering of Clemson A&M College, Clemson, S. C., presented to the Woman's Auxiliary to the ASME a copy of the biography of "Thomas Green Clemson, His Life and Works." This biography is to be passed along to the future Auxiliary President with the Auxiliary gavel.

The gavel presented in 1938 and designated as the "Calhoun Gavel" was made from a lightning-struck oak tree, standing on the grounds of the John C. Calhoun mansion, which is located on the Clemson College Campus.

Mr. Calhoun, who was Vice-President of the United States from 1825 to 1832, willed his plantation, including the mansion, to his son-in-law, Thomas G. Clemson.

Mr. Clemson, Philadelphia born, was a mining engineer, the first superintendent of Agricultural Affairs of the U. S. under President James Buchanan; an officer in the Confederate States Army; and an active promoter of scientific education in the U. S. Mr. Clemson donated the bequest to the State of South Carolina; to establish a "college of engineering and agriculture." In memory of the donor, it was named, "Clemson College."

From 1898 to 1901, William H. Boehm, Mem. ASME, 1900, deceased 1957, was the professor and director of engineering at Clemson College. Mr. and Mrs. Boehm lived adjacent to the Calhoun mansion. On the day the tree was struck, they were standing at one of their windows, looking directly at it. Mrs. Boehm served as President of the Woman's Auxiliary from January, 1936, through December, 1937.

At the close of her term as President, in 1952, Mrs. Frank W. Miller refinished the gavel and had an engraved silver nameplate mounted on one of the rounded ends of the gavel head. The inscription reads, "Woman's Auxiliary to the ASME National Board 1938."

Six students from Clemson College have recently been granted loans from the Student Loan Fund. One student has been awarded a Sylvia W. Farny Scholarship of $500.

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A. S. GOLDSTEIN

JUNIOR FORUM

Plastics in Industry

By Charles L. Andrews, III[2]

The field of plastics offers many opportunities to all types of young engineers since undergraduate colleges do not generally offer courses in plastics. New ideas are welcome, new methods accepted, and new talent required. Basic knowledge and logical interpretation are the keynotes for progress.

One point that is critical to the plastics industry in relation to other industries is the fact that plastic materials are not substitutes. To appreciate and use plastic materials, they must be considered as basic products with original and specific characteristics which should be taken advantage of for various applications. During the war years, plastics received a black mark due to the fact that a shortage of essential metals forced manufacturers to go to plastics even though the applications were not correct. However, plastics are neither limited nor inexpensive. Certain plastics have capabilities that no other materials on the market can approach. One of these is a fluorocarbon resin which no chemical substance will attack. This plastic also has a heat range from -500 to $+500$ F.

We should understand what a plastic is, before discussing it. A dictionary definition is, "Plastic is a material capable of being deformed continuously and permanently in any direction without rupture." This covers a rather large area which means that at times, materials that could be considered plastics are also metals, glass, clay, wood, and even minerals. Actually, plastics are just another material that can be formed and handled by mankind to produce useful products. The large difference is that plastic materials, as we commonly call them, are man-made and are not found in their natural form. The definition of plastics generally accepted, according to *Modern Plastics*, is, "Plastics are a large and varied group of synthetic materials, each consisting of or containing as an essential ingredient, an organic substance of high molecular weight which, while solid in the finished state, at some stage in its manufacture is made soft and thus capable of being formed into various shapes. Most usually through the application either singly or together of heat and pressure." The materials worked with are produced basically through the synthesis of such raw materials as water, air, coal, salt, natural gas, and cellulose. Because many different combinations of such materials are possible, the family of plastics encompasses a large and still growing number of members, all with different properties and characteristics.

A thermoplastic material is one which becomes plastic through heat and pressure but only goes through physical changes. That is, after it is made into a part it can be reheated to a molten state and reprocessed again to produce a different part. The other basic type is a thermosetting material. The thermosetting material, through heat and pressure, undergoes an actual molecular change. Once this change has taken place, it is irreversible and it is not possible to revert the material to its original form. The impetus of the war years has made possible great strides both in materials and methods. To illustrate the growth in these years, from 1942 to 1958, the annual consumption of plastics went from 500 million lb to $4^1/_2$ billion lb. This sounds rather large but would present a different picture if actually put into ton-figures, such as used in the metals industries. To obtain this large expansion, plastic materials have entered many markets and have had to draw from a great many other markets.

Plastics make use of all types of steel for dies. It has opened up new avenues in tool and die work since it has problems which are not specifically connected to other types of work. Some large dies will weigh as high as 3000 or 4000 lb.

Screw-machine parts are continuously being used as inserts in all molded plastics parts. Some parts such as a nylon gear might have one piece of steel which will act as a hub. Parts going into the electronics which have to be assembled can have as high as 12 or 15 metal inserts. This work has opened up a new outlet to the screw-machine people and provided them with a good steady business. Special types of shreaded and pulverized metals are both being used in casting of epoxy resins to give them strength and used with polyester-type materials in making laminated parts. Recently, shreaded aluminum has been used successfully in place of glass for reinforced plastics.

One of the largest fields in plastics is coating metal with vinyl materials to give a smooth surface or a surface that appears to have a leather grain. The vinyl is attached to the metal in a continuous process and then the parts are stamped and formed afterward. It has been found that the vinyl material will take up to a 30 per cent elongation in forming processes. The piping companies have found that by coating both the insides and the outsides of pipes with various types of plastics for corrosion resistance, they have been able to substantially increase their market and enter new areas which compete economically with the use of metals. Now, by using a less expensive steel and a plastic coating, they can perform the same job as a special and expensive corrosion-resistant steel.

Plastics should never be considered as an individual product that cannot be used with other materials. It is found that plastics enhance and greatly extend the usefulness of present materials. With the new plastics entering the market, plus the improved methods of fabricating and producing them, the extent of their use is beyond one's imagination.

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[1] Engineering writer, General Electric Advanced Electronics Center at Cornell University, Ithaca, N. Y. Assoc. Mem. ASME.

[2] Laboratory manager, Chicago Molded Products Corporation, Chicago, Ill. Assoc. Mem. ASME.

The future will have things such as expandable foams both in polyurethane and polystyrene. These foams are used in housing where they are sandwiched between aluminum sheets for walls, and are also used as "foamed-in-place" insulation on refrigerator trucks. Another large field is the epoxy resins which allows small manufacturers to make experimental dies and short-run dies for both producing plastic parts and for stamping metal parts. In many cases, this allows a manufacturer to go to a metal-stamping die for low-cost tooling.

Still another large area is adhesives. This was pioneered by the aircraft industry when they produced honeycomb structures for aircraft by laminating and adhering metal sections with special adhesives. Here, with the help of plastic adhesives, metals will be fabricated in ways that were not possible before. Another field is paints which give better protection and better surface finish on metal parts. These paints again will open new fields where problems of corrosion and outdoor weathering resistance tended to limit possibilities.

Throughout this fast-growing industry are needed young engineers of all backgrounds. Ground breaking is the usual procedure and offers an excellent chance to get on the "ground floor" of an expanding field. Plastics in industry adds up to new horizons and new uses.

Everyone should be cognizant of the field and its developments. The right type of plastic can always enhance or improve any type of basic material. The intelligent choice and use of plastics can better your product and widen your field of applications.

Chairman's Corner

The response to the request for articles written by associate members on subjects of interest to young engineers has been most gratifying. More articles are always welcome. If you wish to become active in National Junior Committee activities or submit articles of interest to the Junior Forum, write to:

A. S. Goldstein, *Chairman*
Junior Forum Subcommittee
National Junior Committee
Advanced Electronics Center
General Electric Company
Ithaca, N. Y.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print **ASME Master-File Information** ______ Date

______ LAST NAME ______ FIRST NAME ______ MIDDLE NAME

______ POSITION TITLE ______ NATURE OF WORK DONE
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

______ NAME OF EMPLOYER (Give name in full) ______ Division, if any

*☐ ______
EMPLOYER'S ADDRESS City Zone State

______
ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐ ______
HOME ADDRESS City Zone State

☐ ______
PRIOR HOME ADDRESS City Zone State

* CHECK "FOR MAIL" ADDRESS

I subscribe to

Address changes effective when received prior to:

☐ MECHANICAL ENGINEERING — 10th of preceding month
☐ *Journal of Engineering for Power*
☐ *Journal of Engineering for Industry*
☐ *Journal of Heat Transfer*
☐ *Journal of Basic Engineering*
☐ *Journal of Applied Mechanics*
} 20th of preceding month
☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation
☐ B—Applied Mechanics
☐ C—Management
☐ D—Materials Handling
☐ E—Oil and Gas Power
☐ F—Fuels
☐ G—Safety
☐ H—Hydraulics
☐ I—Human Factors Group
☐ J—Metals Engineering
☐ K—Heat Transfer
☐ L—Process Industries
☐ M—Production Engineering
☐ N—Machine Design
☐ O—Lubrication
☐ P—Petroleum
☐ Q—Nuclear Engineering
☐ R—Railroad
☐ S—Power
☐ T—Textile
☐ U—Maintenance and Plant Engineering
☐ V—Gas Turbine Power
☐ W—Wood Industries
☐ Y—Rubber and Plastics
☐ Z—Instruments and Regulators

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC

[Agency]

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical, and Petroleum Engineers, is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 per cent of the first year's salary if a nonmember, or 4 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for nonmembers, payable in advance.

NEW YORK
8 West 40 St.

CHICAGO
29 East Madison St.

SAN FRANCISO
57 Post St.

Men Available[1]

New York Office

Environmental Engineer, BSIE; 37; evaluation and testing of thermal and vibration problems in precision instruments, optical and electronics. Devise and develop special testing devices for afore-mentioned; eight to ten years' experience. Prefers Midwest, East of Chicago. Me-744.

Engineering Administrator, BSME, MA; 31; nine years' broad experience in project, liaison, and operational engineering, economic analysis, marketing and distribution surveys, statistical reports, managerial and supervisory responsibilities with blue chip corporations, including last two years staff assignment in South Asia. Desires career position with large organization having foreign operations. Prefers overseas, Latin America, or Europe. Me-745.

Process-Plant Design, Estimating, Construction; BSME, PE; 34; chemical and petroleum facilities, experienced foreign operations, desires responsible position with progressive growing company. Will consider any U. S. or foreign location. Me-746.

Technical Buyer, BSME; 39; five years' experience procurement and purchasing mechanical equipment, heavy weldments; $2\frac{1}{2}$ years design oilfield equipment, pressure vessels, etc.; $2\frac{1}{2}$ years sales and service engineer, branch manager for service company. Prefers Northeast or Southeast. Me-747.

Plant Manager. Seasoned executive desires challenging position; experienced in design, manufacturing, tooling, cost control, large or small industry, setting up of new plant; union or nonunion. Prefers eastern U. S. Me-748.

Mechanical Engineer, BME; 23; $1\frac{1}{2}$ years safety engineer; six months test engineer, reciprocating engines; three years research assistant. Prefers New York area. Me-749.

Mechanical Engineer, MSME; 53; 16 years' experience in steam-power plant operation, maintenance, and design. Nuclear power training. Licensed PE. Will travel. Location immaterial. Me-969-Chicago.

Mechanical Engineer, BSME-IE, Business Administration; 42; 10 years' consulting experience as principal, vice-president, senior consultant. Ten years' experience as process engineer, machine and tool designer, and machinist. Requires $17,500 a year. Location or travel immaterial. Me-970-Chicago.

Plant or Project Engineer, BSME; 35; background in field service, installation, control, design, start-up, construction, maintenance, operation, fabrication, estimating, purchasing, management and organization in power, chemical, and metallurgical industries. Requires $12,000 a year. Prefers Midwest, South, West. Me-971-Chicago

Director of Research and Development in Heat Transfer; BS and MS(ME); 36; 11 years' experience in conduction and convection heat transfer; involving design, manufacturing, instrumentation, testing, and customer liaison; particularly strong in compact heat exchangers. Location immaterial. Me-973-Chicago.

Project Engineer, BSME; 25; three years' experience design and development of small mechanisms including controls. Requires, $7800 a year. Prefers Midwest or East. Me-974-Chicago.

Engineering Manager, MSME; PE; 40; 12 years responsible project supervision in automotive and related engine, accessory, chassis, and control design and development, six years including planning, management presentations, and administration. Analysis, design, test, demonstration; computer analysis of systems; lab tests and experimental car operation. Location immaterial. Me-979-Chicago.

San Francisco Office

Industrial Engineer—Electronic, Manufacturing: PhD, Prod E, MS, IE; 41; two years supervising cost analysis, standards, and systems for electronic semiconductors and aircraft components for aircraft company; three months responsible for development of facilities, methods, and operation on storage, depot, and maintenance for government; two years teaching, research for production engineering, seven years consulting work on construction of petroleum installations, underground storage tanks, related facilities for petroleum companies. $225 week. Prefers San Francisco or Los Angeles. S(M)-1838.

Design, Teach—Machine, Mechanical: MS ME; 27; two years design, development on industrial compressors and mining equipment for manufacturer; two years teaching and research on machine design. $7500. Prefers Calif., Pacific Northwest. Home, Ind. S(M)-1767.

Production—Ship Repair, Construction: ME; 49; nine years' experience, studies, design, and installation, supervision of building and repair for ship manufacturing; six years' experience machine tests, performance, overhaul, schedule, plant maintenance, and operation for electric-power-generating utility. $12,000. Prefers Southern Calif., Pacific Coast. S(M)-1609.

Production, Manufacturing—Metals, Foods, Wood Products: IE, 54; nine years' experience supervision, direct manufacturing and industrial engineering in food process, cosmetics, wood, metal fabrication and assembly for management-engineering consultants; 13 years charge of development, design, production, industrial engineering, subcontracts, plant expansion for ammunition loading, farm implements manufacturer, aircraft contract and domestic appliance manufacturer. $15,000. Prefers West, Southwest. Home: Mich. S(M)-907.

Superintendent, Plant Engineer—Construction, Heavy Manufacturing, Mining: MinE, Calif. ME License; 54; 13 years on plant layout, construction of grain storages, feed mills, chemical plants, commercial, residential construction; three years senior engineer on floating dry docks, for Navy; five and one-half years plant superintendent, manager on mining, milling facilities for mining companies. $600. Prefers San Francisco Bay area, or any. Home: East Bay. S(M)-1756.

Engineering Executive: ME, 55; 25 years in foods, beverages, and chemicals; ten years at multiplant corporation level. Broad experience in selection of talent, co-ordination of effort, direction of budget and costs and appreciation of adequate return on investment. Immediate compensation secondary to opportunity of sharing in rewards of his efforts. S(M)-186.

Sales—Pump, Transmissions: ME Aero E; 33; six years assistant sales manager, promotion, advertising, on pumps and transmissions for manufacturer; four years charge of methods and wage incentives for aluminum-fabricating mill. $10,000. Prefers San Francisco Bay area. Home: Minn. S(M)-1504.

Plant Engineer—Machinery, Wood Products: 50; three years manager, charge of engineering, sales, manufacturing of sawmill, pulp and paper machinery; four years chief engineer on design, planning for job-machine shop; 21 years plant engineer on hardboard, lumber products. $700. Prefers San Francisco Bay area. Home: SF Peninsula. S(M)-1457.

Positions Available

New York Office

Industrial Engineer, to 45, graduate mechanical or industrial engineer, experience in heavy industry, including steel fabrication, forging, foundry, and machine shops. Competent to plan and direct industrial-engineering program for large multiplant operations, 20,000 employees including studies for plant equipment and layout. $20,000–$25,000. Headquarters, central Northeast. W-7712.

Chief Engineer, mechanical graduate, at least five years' supervisory design and product-development experience covering hardware, stampings, and auto accessories. Thorough knowledge of dies essential. $12,000–$15,000. Company will pay placement fee. Conn. W-7719.

Associate Editor, at least three years' technical-writing experience in industrial-manufacturing fields. $8000–$10,000. Mass. W-7728.

Chief Engineer, graduate mechanical or equivalent, at least ten years' experience in heavy structural and processing equipment. Should have or be qualified to obtain PE license in mechanical engineering. Knowledge of theoretical mechanics and structures is essential. $12,000–$15,000; liberal profit-sharing plan, hospitalization, etc. Company pays placement fee. Pa. W-7744.

Chief Tool Engineer, mechanical graduate, at least ten years' tool and die design, planning and process development covering steel forging and heavy machining. $11,000–$13,000. Western Pa. W-7759.

Senior Product Designer, graduate mechanical engineer, 30–45, ten years' product-design experience in one or more of the following fields: (1) Photographic equipment, (2) microfilming equipment, (3) graphic arts, (4) office machinery. Must have well-rounded background covering a multiplicity of products including optical, mechanical, and electrical design. $12,000–$15,000. Company will pay placement fee. Upstate N. Y. W-7763.

Process Engineer, graduate industrial or mechanical, manufacturing background in foundry, plant, and machine shops. Must be capable of determining most economical means of processing and fabricating parts and complete products, specifying the processes, tooling, layout, and facilities required for manufacturing. Salary open; fringe benefits. Western Md. W-7765.

Industrial Engineer, degree in industrial engineering preferred, five to seven years' of additional applicable experience to acquire supervisory ability, to determine areas of greatest need for service, and to learn the applicability of industrial-engineering techniques to cotton manufacturing. Will work under direction, performing responsible operating, administrative, and supervisory duties in directing the industrial-engineering functions including wage incentives, methods analysis, systems, and methods of reporting production for a plant of considerable size. $10,000–$11,000. New England. W-7776.

Material-Handling Engineer, graduate mechanical or industrial, eight to ten years' experience in material handling, preferably in heavy industry. Will establish satisfactory application of new material-handling procedures and practices in a heavy manufacturing (metal working) plant. Responsible for selection, purchase, and application of all material-handling equipment. $8500–$11,000. Upstate N. Y. W-7782.

Project Engineers, 25–35, graduate mechanical, three to five years' experience on industrial multistage and rotary positive blowers, rotary positive displacement meters, compressors, or in lieu of this experience, would consider steam-turbine design experience. Must be interested in and have a desire to continuously perform product-engineering work. $7200–$9000. Midwest. W-7783.

Design Engineer, mechanical graduate, at least five years' special and automatic machinery-design experience, to design and lay out packaging and processing machinery. $8000–$9000. Conn. W-7794.

Vice-President of Sales, mechanical or metallurgical graduate, considerable sales management and sales promotion experience covering nonferrous metals and fabricated products. $35,000 plus bonus. East. W-7803.

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[1] All men listed hold some form of ASME membership.

Manager, Basic Research (Propulsion), for company in the automotive field, 33–45, PhD desirable, MSME required, to plan and supervise the conduct of basic research in the fields of combustion, thermodynamics, lubrication, fuels, metallurgy, instrumentation, turbomachinery, and related fields with an ultimate goal of providing new discoveries to be incorporated into company products. Some product background in internal-combustion engines; industrial experience with aircraft or automotive companies or applied research organizations; job experience where research and development activities were aimed toward technical break-throughs. Around $20,000. Midwest. W-7804.

Sales Engineer, 25–35, preferably with five years' experience in the field of refrigeration and/or air-conditioning application or service engineering. Prefer a native of Canada. Traveling Eastern Provinces of Canada contacting manufacturers, wholesalers, and contractors regarding application of accessory items used on all sizes of commercial and industrial-refrigeration systems. Salary and commission plus expenses. Company will pay placement fee. Headquarters, Midwest. F-7806.

San Francisco Office

Designers—Accelerators: ME, 25–35. Recent mechanical-design experience relating to equipment encountered in accelerators at project-engineering level. Able to perform on board, desk, or in field assisting in selection and design of components and principal parts in individual units of a system (heat transfer, fluid flow, temp control, gearing, limiting switches, vacuum-type openings, cooling equipment, microwave components and guides, electromagnetic material, all of medium size) for construction operation. $600–$800. San Francisco Bay area. S(P)-4594.

Technical Writer—Mechanical: Mechanical background. Minimum two years' experience preparing breakdown summaries, and comments to co-ordinate material from drawings and specifications relating to controls and operating mechanisms (electronic, electrical, electromechanical), similar to missile-type equipment. Must be literate and able to prepare technical writings requiring minimum of editing. San Francisco. S(P)-4593.

Systems Engineer—Postal Machinery, Services: Experienced in work measurements, methods, studies, services, to develop new improved systems, new concepts, and design of equipment, mail handling, sizes on postal service, analyze information. (*a*) ME, EE, or Physics graduate, good statistician or mathematician, five to ten years' experience, strong on statistical work, analysis, evaluate maintenance information. (*b*) EE, ME, or Physics graduate, five to ten years' experience primarily in analytical work, applied mechanics, circuit experience, some computor experience desirable. $700–1000/mo. For manufacturer. San Francisco Peninsula. S(P)-4591.

Senior Industrial Engineer—Postal Services: Graduate ME or EE, who has gone into industrial work. Should be experienced in human engineering, work measurements, methods studies; to develop new improved systems, new concepts and design of equipment for postal service, work closely with postal employees, co-ordinate (not time study). ,$700–1000/mo. For manufacturer. San Francisco Peninsula. S(P)-4590.

Production Superintendent—Electronic Components: ME, EE, Phys Electronics or Prod Management; under 40; well qualified by experience to take charge of several hundred men or production line under the works manager. Should be experienced in electronic-components manufacturing and acquainted with semiconductors and their use. Must be aggressive and currently employed in this field. For manufacturer of electronic component. Placement fee and relocation cost paid. $12,000–$15,000. San Francisco Bay area. S(P)-4589.

Industrial Engineer—Electronics: ME, with IE, young, qualified by experience in highly mechanized, high-speed production on small precision, close-tolerance parts manufacturing. With substantial interest and capabilities in unique and effective mechanization for manufacturer of electronic components. $500–850. Placement fee and relocation costs paid. San Francisco Bay area. S(P)-4588.

Designer—Tools: ME, well qualified by experience to design precision, close-tolerance tools, fixtures, and jigs for production work on electronic components. Experienced in tool-room practice and knowledge of stamping machine-shop equipment (lathes, millers, borers, automatics, etc.) and informed about tooling for mechanical-production machinery. For a manufacturer. Product transistors. Placement fee and relocation costs paid. $600–700. San Francisco Bay area. S(P)-4586.

Design—Mechanisms: ME, three to five years experience preferably in design of small mechanisms and components; familiar with close tolerance. $700–900, depending on experience. U. S. citizen. San Francisco Bay area. S(P)-4584-a.

Plant Engineer—Metal Structures: ME or IE, under 30. Recent graduate or up to ten years' experience, preferably with shop experience, for plant and tool engineering, including methods engineering, tool, jig, and fixture design, plant layout, maintenance. Able to plan and carry out plant-engineering projects. $500–650, depending on age and experience; plus production bonus which frequently reaches 20 per cent, retirement plan, and fringe benefits. For manufacturer of aluminum pipe and fitting structure. San Francisco East Bay. S(P)-4559.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after Sept. 25, 1959, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

California

●Applin, Ronald, Culver City
●Casey, Donald F., Reseda
●Chobotov, Vladimir A., Los Angeles
Fisher, Eugene J., Los Gatos
Fong, Samuel, Sacramento
●Franz, Donald C., La Mirada
Griswold, James W., South Pasadena
Holliday, George H., Los Angeles
●Jacobson, Jerome, Campbell
Jarren, Bert, Downey
Nay, Samuel W., Sun Valley
●Olich, Eugene E., San Jose
Pierce, David A., Inglewood
●Pruce, Peter P., Los Angeles
●Reis, Paul S., Sacramento
Rutherford, Robert E., Sacramento
Schliesmann, Raymond G., Long Beach
Slocum, True R., Jr., Northridge
Wein, Thomas S., N. Hollywood
Wirganowicz, Zygmunt, San Francisco

Connecticut

Badger, Frederick W., Hartford
Jankura, Michael, Jr., Fairfield
●Johnson, Walter G., Bridgeport
●Larson, Jordan L., Jr., W. Hartford

●Transfer to Member or Affiliate.

Delaware

Norman, James E., Newark

Florida

Horton, Arthur L., Jr., Tampa
●Snier, Thomas J., Eau Gallie

Illinois

●Dildine, Dean M., Downers Grove
Karbowniczek, Stanley W., Chicago
LeForge, Forrest G., Grand Tower
●Martinec, Emil L., Downers Grove
Zastera, Ruldolph J., Glen Ellyn

Indiana

Carlson, Herbert E., East Chicago
Roberts, Arthur L., Fort Wayne

Kansas

Fulkerson, John C., Mission
●Pennington, Bruce R., Jr., Mission

Louisiana

Beach, George A., Jr., New Orleans
●Landry, Walter A., New Orleans
●Quartana, Joseph J., New Orleans
●Shaw, John E., Jr., New Orleans

Maryland

Barr, William A., Gibson Island
●Scholly, Christian, Baltimore

Massachusetts

Harty, William B., Boston
●Hopkins, Bryant L., Jr., Scituate
Mello, Angelo M., Jr., New Bedford
Pinney, Frank B., Milton

Michigan

Anselm, Rolf E., Flint
Hutchins, Charles S., Ann Arbor

Minnesota

Irvine, Thomas F., Jr., Minneapolis

Nebraska

Wilson, Neal E., Beatrice
Zimmermann, Karl W., Omaha

New Jersey

●Brandmaier, Harold E., Harrington Park
●Bridgeman, John R., Newark
●Fromm, Charles W., Teaneck
●Knecht, Harry C., Camden

New Mexico

Ju, Frederick D., Albuquerque

New York

●Baron, Melvin L., New York
●Beauchemin, William E., Williamsville
Breunich, Theodore R., White Plains
Decker, Otto, Bayshore
Demro, Samuel T., New York
Dillenbeck, Warren H., Syracuse
Dombrowski, John P., Apalachin
●Flynn, Paul D., Schenectady
●Honigsberg, Charles A., New York
●Jensen, Jack E., Upton
●Kingston, William J., Rochester
Marguin, Joseph J., Latham
●Newman, Carl S., Rockville Centre
Ojalvo, Irving, Bronx
Raider, Jerry W., Endicott
●Ross, Robert C., Rochester
●Roth, Bernard N., N. Bellmore
Tadjbakhsh, Iradj G., Troy
Tu, Yih-O, Yorktown Heights
Zounek, George F., Johnson City

Ohio

●Bullard, Nelson H., Jr., Akron
Edick, John D., Wickliffe
Fulton, Samuel R., Dayton
Koffel, William K., Cincinnati
Stuckey, Richard L., Alliance

Oklahoma

Chaple, William F., Oklahoma City

Pennsylvania

●Brown, Luther P., Jr., York
de Jong, Klass F., Pittsburgh
●McCormack, Webster J., York
McGarrigle, Robert D., Philadelphia
Morrison, Thomas W., Jenkintown
Piniella, Jose O., Pittsburgh
Schenker, Robert H., Philadelphia
Seth, William B., Pittsburgh
Sun, Wellington I. T., Emmaus

South Carolina

●Griffin, Joseph H., Jr., Aiken
Taylor, James, 3rd, Aiken

Texas

●Jensen, Gunther T., Tyler
●Leach, Lemuel L., Jr., Baytown
●Mitchell, Gene A., Dallas
●Wilhoit, James C., Jr., Houston
●Williams, Bernard J., Houston

Utah

Hoj, Henning, Salt Lake City

Virginia

Bush, Richard M., Arlington
●Carr, Guy R., Roanoke
●Dennis, Carl S., Richmond
●Dye, John H., Newport News
Moore, Morrow H., Jr., Arlington
Sells, Harold R., Springfield

Washington

●Kintz, Arthur H., Richland

Wisconsin

Andersen, Gordon W., Milwaukee
Gherr, David P., Milwaukee
●Manning, Robert F., Milwaukee
●Sanderson, Howard M., Milwaukee

Foreign

Cole, John A., Nedlands, Western Australia
Fairlie, James M. L., Stoneygate, Leicester, England
Franzius, Juan E., Caracas, Venezuela
Hernandez-Galan, Jose L., Mexico City D.F., Mexico
Novakoff, Andrew, Montreal, P.Q., Canada
Roy, Nagendra K., Hazaribagh, Bihar, India
●Wilde, John W., Islington, Ont., Canada

OBITUARIES

George Lightbourn Bascome (1881–1959?), whose death recently was reported to the Society, had been with the State Corporation Commission, State of Virginia, Richmond, Va. He was retired. Born, Brooklyn, N. Y., Aug 26, 1881. Parents, George D. and Ada (Strang) Bascome. Education, ME, Cornell University, 1905; postgraduate study at Cornell and University of Illinois. Mem. ASME, 1919. Married Abbie Tuttle, 1913. Mr. Bascome held several patents for lubrication-governor and valve parts. He was a registered professional engineer in the States of Pennsylvania and Virginia. He served the Virginia Section, ASME, as vice-chairman, 1937–1938; and chairman, 1938–1940. He was a member also of AIEE.

Harrison Roswell Cady (1886–1959), consulting engineer, West Englewood, N. J., died April 11, 1959. Born, East Chatham, N. Y., Jan. 18, 1886. Education, ME, Syracuse University, 1909. Assoc. Mem. ASME, 1916; Mem. ASME, 1954. From 1927 until his retirement in 1951, Mr. Cady had been mechanical engineer in charge of operation, maintenance, and new equipment for the Hackensack Water Co. He was a registered professional engineer in the State of New Jersey. Member also of the American Water Works Association. Survived by his widow.

Hilmer Walfred Carlson (1920–1959), project engineer, South Wind Div., Stewart-Warner Corp., Indianapolis, Ind., died Feb. 2, 1959. Born, Marengo, Ill., May 24, 1920. Education, BS(ME), Illinois Institute of Technology, 1943. Assoc. Mem. ASME, 1946. Before joining Stewart-Warner, Mr. Carlson had been with Combustion Engineering and Western United Gas and Electric Co., Aurora, Ill. He also served in the U. S. Navy.

Frank G. Carrington (1892–1959), vice-president, Pontex Pipe Corp., Lynchburg, Va., died May 5, 1959. Born, Jasper, Ala., Feb. 21, 1892. Education, attended Alabama Polytechnic Institute. Mr. Carrington had been a specialist in the field of foundry machines and methods. During World War I he served in the U. S. Army. Mem. ASME, 1942, and a member also of the American Foundrymen's Association.

Hobart Valentine Cornwell (1891–1959), consulting engineer, New York, N. Y., died May 15, 1959. Born, Hempstead, N. Y., Jan. 22, 1891. Education, ME, Cornell University, 1913. Jun. ASME, 1914; Mem. ASME, 1924. Within ten years after his graduation from Cornell, Mr. Cornwell was president of the Engineering Supervision Co., Inc., New York. He served in the U. S. Army during World War I. He was a registered professional engineer in the State of New York.

Howard H. Dalton (1880–1959?), retired, formerly power engineer with American Sugar Refining Co., died recently according to a report received by the Society. Born, Philadelphia, Pa., Jan. 31, 1880. Parents, James and Sarah Jane (Johnston) Dalton. Education, attended night courses at Drexel Institute. Married Estelle Meret, 1905 (died 1920); one daughter, Ruth Estelle Dalton. Married 2nd, Wilma Wiese, 1921; a son, Howard Henry, and a daughter, Barbara Jane. Mem. ASME, 1920. Mr. Dalton had been with American Sugar Refining since 1919.

Harvey Ellis Davidson (1904–1959), chief engineer, Bethlehem Steel Co., Supply Div., Tulsa, Okla., died May 14, 1959. Born, Hope, Kan., April 10, 1904. Education, attended Kansas State College. Mem. ASME, 1957. Mr. Davidson had been employed by the steel company since 1941. He held several patents pertaining to oil-field machinery. He was a member also of ASTM, and was active on many API standardization committees. Survived by his widow, Clara; two daughters, Mrs. Lucille Scott and Marilyn Davidson; and a sister, Mrs. Frances Bosin.

Alton Frank Davis (1889–1959), vice-president and secretary, Lincoln Electric Co., Cleveland, Ohio, died May 25, 1959. Born, Diamond, Ohio, Oct. 24, 1889. Parents, Frank James and Hattie (Hiser) Davis. Education, attended Mount Union College; ME(EE), Ohio State University, 1914; hon. DS, Mount Union College, 1951. Married Carrie E. Spring, 1921. Mem. ASME, 1943. Mr. Davis joined Lincoln Electric immediately after graduation, became a director and vice-president in 1925, and in 1938 became secretary. He was responsible for the company's educational program which was significant in development and expansion of the welding industry. One phase of the program was the publishing of more than one million copies of technical books on various aspects of arc welding. He operated the Lincoln Welding School; was the publisher of the *Stabiliser*, a magazine sent to welders all over the world. He was also secretary of The James F. Lincoln Arc Welding Foundation which was created by the company in 1936 to stimulate scientific progress of the arc welding industry. He was the 1954 recipient of the AWS Samuel Wylie Miller Medal for his contributions to welding education. He was also president of the board of trustees at Euclid-Glenville Hospital, and a member of the board of trustees' executive committee of the Cleveland Hospital Service Association. He was a member also of AWS, ASEE, ASM; and a member of Eta Kappa Nu, honorary electrical fraternity. Survived by his widow; a daughter, Mrs. Shattuck Hartwell; and two grandchildren.

Elmer John Dreyer (1889–1959?), who was retired and living in Lowell, Ind., died recently according to a notice received by the Society. He had formerly been a sales engineer with Henry Vogt Machine Co., Louisville, Ky. Born, Portage, Wis., Oct. 31, 1889. Parents, Henry Carl and Ida Dreyer. Education, BS, University of Wisconsin, 1911. Married Hilda M. Matson, 1913. Mr. Dreyer had joined the Vogt firm in 1923. He was the author of several published papers on steam-generating units. Jun. ASME, 1916; Assoc-Mem. ASME, 1924; Mem. ASME, 1924. Survived by his widow.

Frank Edward Eberhardt (1883–1959), president and general manager, Newark Gear Cutting Machine Co., Newark, N. J., died May 23, 1959. Born, Newark, N. J., Dec. 28, 1883. Parents, Henry E. and Annette Eberhardt. Education, LLB, Cornell University, 1904. Married Alice E. Schultz; daughters, Margaret and Katherine. Assoc. Mem. ASME, 1907; Mem. ASME, 1925.

Martin Frisch (1899–1959), vice-president and director of advanced engineering, Foster Wheeler Corp., New York, N. Y., died June 16, 1959. Born, Csebze, Hungary, Nov. 22, 1899. Education, BS(ME), University of Illinois, 1921. Married Anita Laurence Barnard, 1937. Jun. ASME, 1922; Assoc-Mem. ASME, 1929; Mem. ASME, 1935; Fellow ASME, 1951. Mr. Frisch had been with Foster Wheeler since 1929. He was also a director of General Regulator Corp. He held 52 patents for fuel pulverization, steam generating, combustion, and manufacturing methods; and made numerous contributions on the subjects to the technical press. Mr. Frisch served the Society as a member of the Boiler Code and Nuclear Energy Applications Committees. He was a member also of the Welding Research Council, the American Society of Naval Engineers, and the Armed Forces Chemical Association. He was a registered professional engineer in the State of New York. Survived by his widow.

Ira Bertram Hebert, Jr. (1936–1959), proposal engineer, State of Louisiana, Department of Highways, Baton Rouge, La., was killed in an automobile accident on April 9, 1959. Born, Jeanerette, La., Dec. 11, 1936. Education, BS(ME), Louisiana State University, 1958. Assoc. Mem. ASME, 1958. Survived by his parents, Mr. and Mrs. I. B. Hebert of Jeanerette, La.

Henry Casper Lewis (1875–1958), engineer in charge of shop costs and design, Charleston Electrical Supply Co., Charleston, W. Va., died Dec. 2, 1958. Born, Columbus, Ohio, Feb. 23, 1875. Education, high-school graduate and ICS course in mechanical and electrical engineering. Mem. ASME, 1939. Mr. Lewis had been employed by the Charleston Electrical Supply Co. since 1906. He is survived by his widow.

Leon Thomas Mart (1891–1959), chairman of the board, The Marley Co., Inc., Kansas City, Mo., died May 17, 1959. Born, Portland, Maine, June 16, 1891. Education, ME, Lehigh University, 1913. Married Clara Wright, 1918; children, Edythe Mart Powell and Thomas Leon Mart (dec.). Mem. ASME, 1942; Fellow ASME, 1952. Mr. Mart formed the Marley organization in 1922 and was its president from that time until 1959 when he became board chairman. During World War I he had served in the Ordnance Corps. As an engineer and inventor in the specialized field of industrial water cooling, he gained world recognition. His books and publications in this field are accepted textbooks in many engineering schools. He held a number of patents pertaining to water cooling towers and was the originator of many types of towers currently in use. Mr. Mart was a registered professional engineer in the States of Kansas and Missouri, and was a leader in professional organization work. He was a member also of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers and was among the founders of The Cooling Tower Institute. He formerly was a director of the Chamber of Commerce of Kansas City and was for many years a member of the school board of his community. Survived by his widow and daughter.

Isaac Vincent Robinson (1879–1959), for 37 years with the British Electrical and Allied Manufacturers Association (BEAMA), London, England, died April 16, 1959. Born, West Hartlepool, England, Oct. 29, 1879. Education, attended Turton Hall College near Leeds; and the Royal College of Science, South Kensington, where he obtained a Whitworth Scholarship. He joined the staff of BEAMA in 1919 and remained with them until his retirement in 1955. Before he was 40 he had earned a reputation through papers presented to the Institution of Civil Engineers on condensing plant, cooling towers, and the torsional vibration of shafts. For the last he received the James Prescott Joule Medal and the Miller Premium. As secretary of the turbine and turbo-alternator section of BEAMA, Mr. Robinson was in close touch with developments. In 1921 he was instrumental in getting the turbine builders to support Professor Callendar in his work on the properties of steam, work which ultimately led to the International Steam Tables Conferences in 1929, 1930, and 1934. He was actively responsible for the publication of the *1939 Callendar Steam Tables* and the *1940 Heat Drop Tables*. Mr. Robinson also represented BEAMA on a number of bodies in England, and in 1933 visited Australia to give evidence before the Tariff Board. Mem. ASME, 1942. Member also of the Institution of Civil Engineers and the Institution of Mechanical Engineers. In 1948 he held the office of president of the Whitworth Society. Survived by his widow, Edith M. Robinson, Carisbrooke, Walton-on-Thames, England.

Frank Leslie Slade (1894–1959), manager, Special Apparatus Div., Century Electric Co., St. Louis, Mo., died March 29, 1959. Born, Mitchell, S. Dak., Sept. 13, 1894. Parents, Leslie B. and Mary (Weeks) Slade. Education, attended the University of South Dakota; BS, (ME), Purdue University, 1921. Married Brunhilda Shreyak, 1925; children, Mary F. and Muriel. Jun. ASME, 1923; Assoc-Mem. ASME, 1924; Mem. ASME, 1935. During World War I, Mr. Slade served in the U. S. Army, Motor Transport Corps. He joined Century Electric in 1932, having previoulsy been employed by Roth Bros. and Co., Chicago, Ill., and Dodge Bros. and Co., Detroit, Mich. He was a registered professional engineer in the State of Missouri. Survived by his widow.

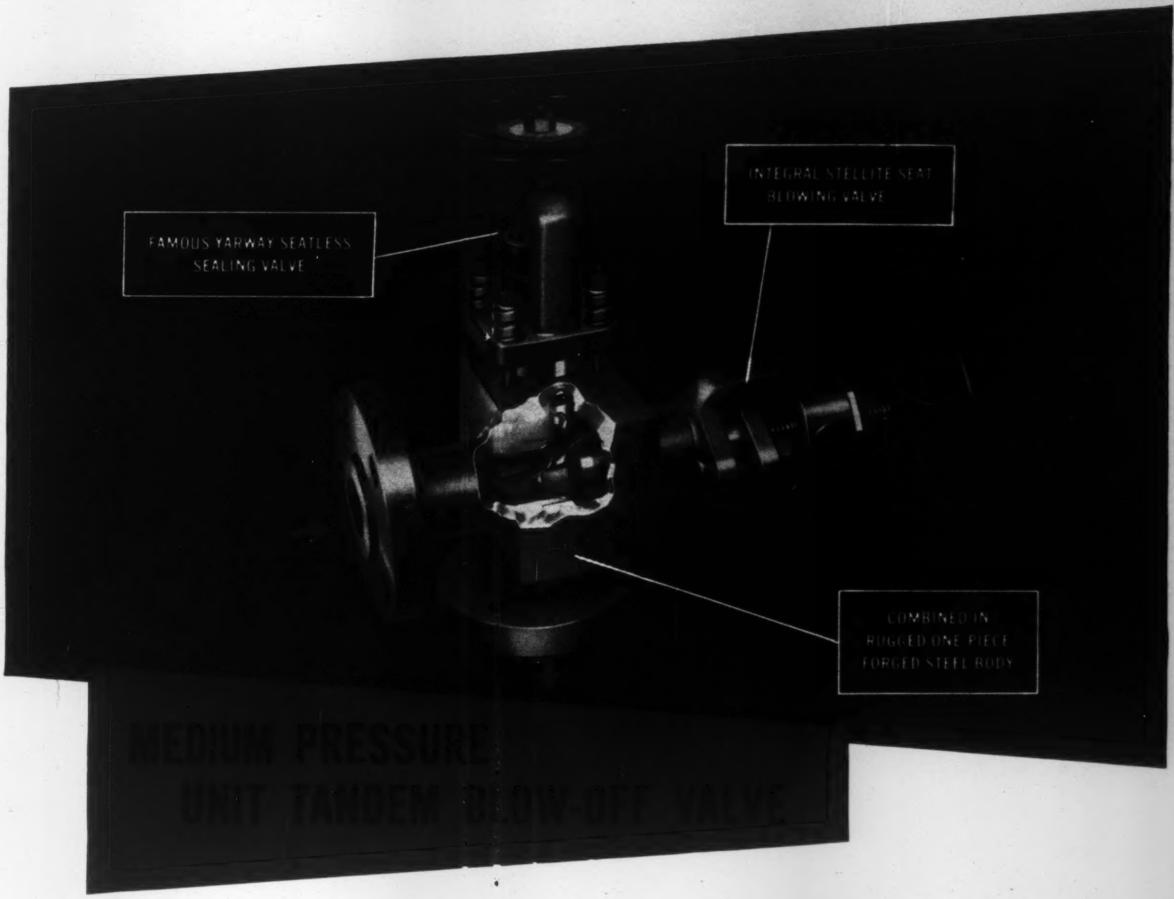
Norman Choate Storey (1881–1959), retired, Youngtown, Ariz., died May 13, 1959. Born, San Diego, Calif., March 18, 1881. Parents, William H. and Clara Ellen Storey. Education, grammar school and apprenticeship in small shops. Married Martha Mary Wright, 1906; two sons, Norman W. and Henry Choate Storey. Assoc-Mem. ASME, 1918; Mem. ASME, 1935. Mr. Storey while associated with the Aguirre Sugar Co., Puerto Rico, recognized a need for improved tillage methods in the sugar-cane fields. and designed and built the first experimental model of a rotary tiller in 1915. This design was highly successful, but it was not until 1931, when John Fowler and Co., Leeds, England, undertook the manufacture of the plough that it became well known throughout the sugar industry. The machine, Gyrotiller by Fowler, was introduced in various sizes in England, Australia, India, Europe, the West Indies, and the U. S. In 1935, Mr. Storey built a manufacturing plant in Miami, Fla., for the production of a variety of special agricultural equipment. During World War II, he acted as a consultant for Consolidated Vultee Aircraft Corp. He retired from active business shortly after the war. He held seven patents on agricultural equipment.

Charles Allen Ward (1887–1959), president, Brown & Bigelow, Saint Paul, Minn., died May 25, 1959. Born, Seattle, Wash., May 29, 1887. Parents, George and Pauline (Kuntz) Ward. Education, high-school graduate. Married Mrs. Yvette Hennig Saunders, 1940; children, Allen, Vida, Herbert. Mem. ASME, 1932. Mr. Ward started with Brown & Bigelow in 1925 in the firm's engineering department. In 1933, he was made president, general manager, and director. He was chairman of the board and director of Graphic Arts Engraving Co., Herb-Shelly, Inc., The Beissel Co., and a number of other firms in the St. Paul area.

William J. Whatley (1896–1959), mechanical engineer, Norman P. Gross, A.I.A., Panama City, Fla., died Feb. 24, 1959. Born, Ashland, Clay County, Ala., Oct. 3, 1896. Education, attended University of Alabama and Michigan College of Mines and Technology. Mem. ASME, 1954. Mr. Whatley was a specialist in the field of plumbing, heating, steam generation, distribution, and utilization. He was a member also of AIME, NSPE, and the National Association of Power Engineers. He held one patent, a support for coaxial fluid conduits; and was the author of several papers published in the technical press.

Robert McCrae Wilson (1910–1959), development engineer, Development and Research Div., International Nickel Co., Inc., New York, N. Y., died June 16, 1959. Born, Montclair, N. J., Sept. 27, 1910. Education, ME, Cornell University, 1932. Prior to joining International Nickel in 1946, Mr. Wilson had been with the General Electric Co. for 12 years. Mem. ASME, 1947. A welding specialist, he was a member also of AWS. Survived by his widow, Carla Meriam Wilson; a son, Robert M., Jr.; and a daughter, Jean Meriam Wilson.

NEW YARWAY MEDIUM PRESSURE BLOW-OFF VALVE FEATURES HIGH PRESSURE DEPENDABILITY


FAMOUS YARWAY SEATLESS SEALING VALVE
INTEGRAL STELLITE SEAT BLOWING VALVE
COMBINED IN RUGGED ONE PIECE FORGED STEEL BODY
MEDIUM PRESSURE UNIT TANDEM BLOW-OFF VALVE

The established success of the high pressure Yarway Unit Tandem Valve is directly responsible for this new medium pressure Yarway Valve. It brings premium quality Yarway dependability to medium pressure boilers (up to 665 psi)—*at a competitive price.*

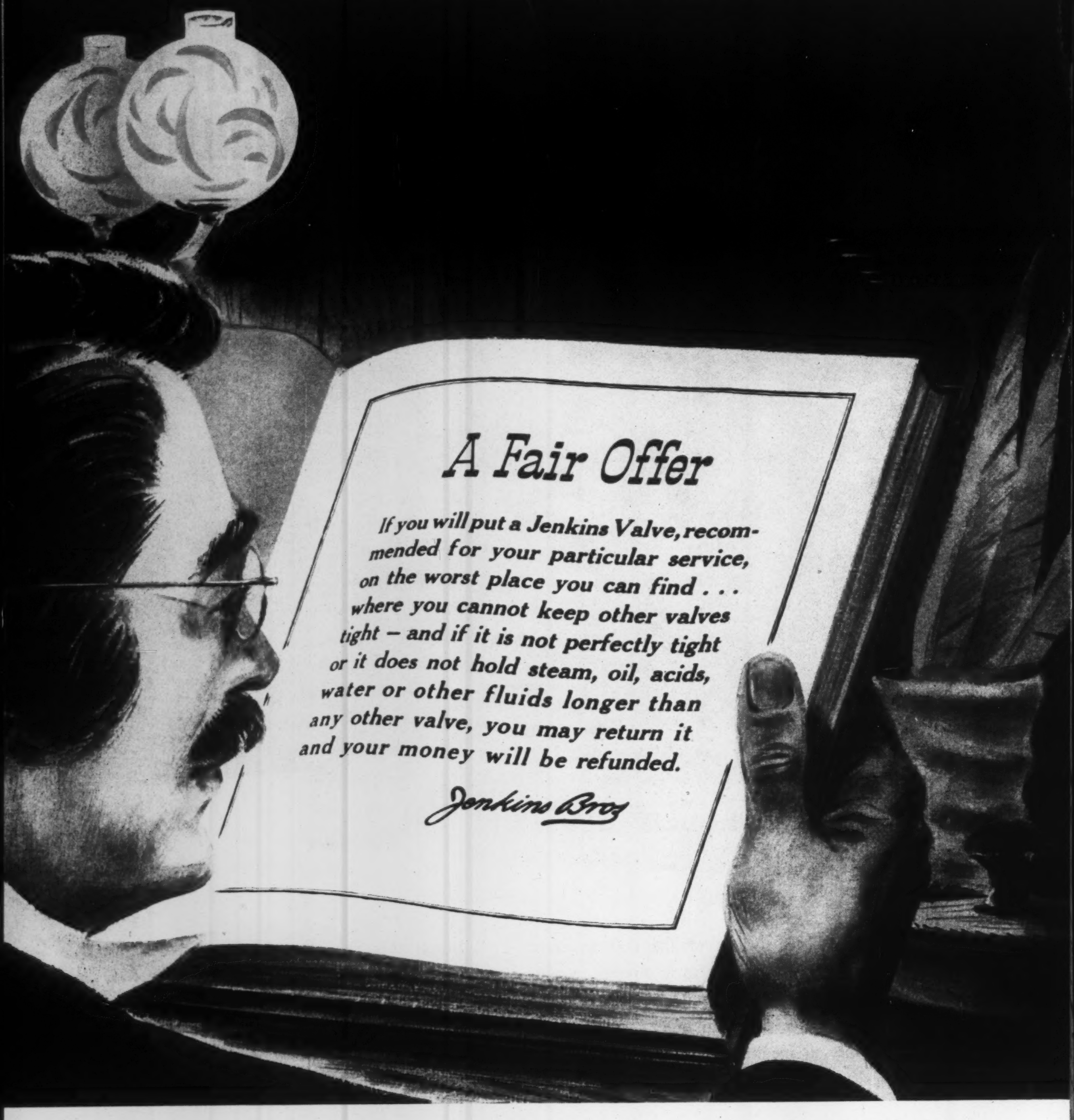
Important Yarway features like nitralloy plunger in the sealing valve, integral stellite seat and disc in the blowing valve, streamlined design, rugged forged steel body—make this your best blow-off valve buy.

Install this new Yarway Medium Pressure Unit Tandem and you'll know why *over 80% of all high pressure plants are Yarway Blow-off Valves.*

Write for Bulletin B-435, Supplement A.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY
IN STEAM ENGINEERING



A Fair Offer

If you will put a Jenkins Valve, recommended for your particular service, on the worst place you can find . . . where you cannot keep other valves tight – and if it is not perfectly tight or it does not hold steam, oil, acids, water or other fluids longer than any other valve, you may return it and your money will be refunded.

Jenkins Bros

PUBLISHED AND PROVED FOR **90 YEARS**

This simple, straightforward statement of selling policy was first published in 1869, five years after Jenkins Bros. was founded. It has been continued in full effect through 90 years of Jenkins Bros. history of making valves to a standard of quality that warrants such an unparalleled assurance to buyers.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS
SINCE 1864
Jenkins Bros

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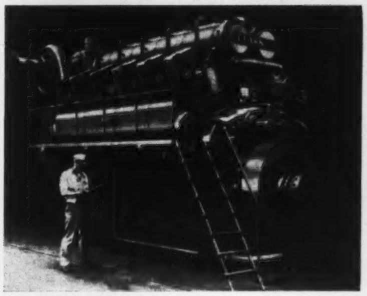
Available literature or information may be secured by writing direct to manufacturer. Please mention MECHANICAL ENGINEERING.

NEW EQUIPMENT



Two-Cycle, V-Engine

Clark Bros. Co., Olean, N.Y. has announced the introduction of a V-Type, turbocharged, two-cycle gas engine.

Designated Model TPV, it is designed as a compact, high horsepower driver for centrifugal compressors in pipe-line booster stations, for power generation and for pump drive.

Featuring 17 × 19-in. bore and stroke, the engine will be built in three sizes—10, 12, and 16 power cylinders—rated at 4000, 4800, and 6400 bhp respectively.

The new V-engine combines low fuel consumption with the simplicity, reliability, and low maintenance costs inherent in two-cycle design, the firm reports.

The unit is equipped with a jet air started turbocharger. At normal operating conditions, it is completely self-sustaining and imposes no parasitic load on the engine. Throughout the entire operating range, turbocharger speed is automatically matched to the engine and requires no attention from the operator, the company states.

Mechanical Seals

A new series of mechanical seals have been developed by Garlock Packing Co. for installation on sealed vessel agitator shafts.

Known as Mechanipak seals, they are completely self-contained in a single unit. The units are designed to prevent agitator shaft leakage at pressures up to 3000 psi and to withstand temperatures in excess of 700 F, even in corrosive environments. The seals are currently available in sizes to fit any shaft.

Hydraulic Power Package

Vickers Inc., Detroit, a division of Sperry Rand Corp., announces its T10 10-gallon power package.

The firm says the new unit will provide hydraulic power and control for a wide variety of industrial machinery applications requiring low hydraulic horsepower. These include gaging, transferring, rollover, elevating, indexing, chuck, and clutch operations.

The basic 10-gallon reservoir covers a floor area of 25 × 14 in. It is regularly equipped with clean out covers, fluid level indicators, combination breather and filter, removable baffle and bottom drain plug.

Optional features include a return line filter with by-pass check valve, a pressure line by-pass filter (with shut-off valve, pressure compensated flow control and gage to show pressure drop through the filter), extra breather, extra oil level indicators, and permanent magnets for removal of metallic particles from the fluid in the reservoir.

High Speed Counter

A new, high speed miniature counter suitable for applications requiring small size and weight, low torque, and low cost, has been announced by Veeder-Root, Inc., Hartford 2, Conn.

The new counter is an external pinion type, with 1/2-in. wheels displaying 1/8-in. white characters on black. The firm says its original application is in an aircraft fuel flow meter, but it may readily be adapted to many applications requiring small overall size, high speed and reliability, and low torque.

The nonreset wheels are of lightweight nylon. Maximum torque is .010 oz-in. at 25 C, and maximum operating speed is 1000 rpm. The complete counter weighs only 1/4 oz, and it will meet military aircraft instrument shock and vibration requirements.

Tape Material

A new dry tape material is now available for doping pipe threads has been announced by Chemtrol, 10872 Stanford Ave., Lynwood, Calif.

Known as Dri-Seal No. 5 it is furnished in 1/2 in. tape width with 300 in. of tape in each roll—sufficient for doping 120 joints of 1 in. pipe sizes.

The firm says only one full turn of the tape around the thread with a small overlap at each end will give you effective sealing. Ends are pressed into the threads and the two sections made up. Because the tape is intensely waxy to the feel it lubricates efficiently and its plasticity readily seals off clearance between threads, the firm reports.

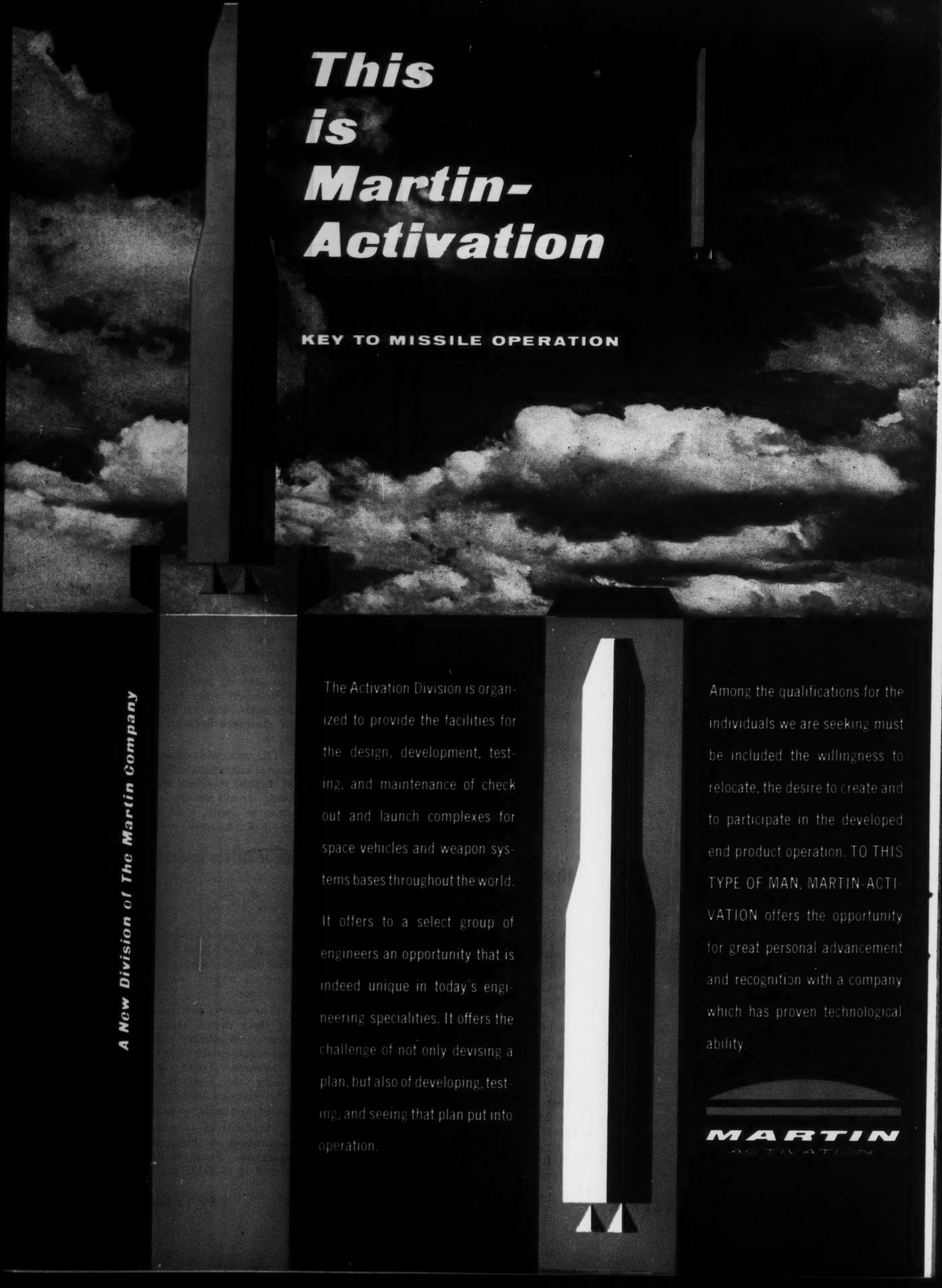
The material is chemically inert, nontoxic, cannot contaminate liquids and, being made of Teflon, possesses resistance to heat and cold. It will not dry out, is easy, quick and clean to apply, seals and lubricates joints in all pipe materials-metal or plastic.

Gear Drives in Steel Housing

Foote Bros. Gear Machine Corp. announces new all-steel Maxi-Power gear drives for the primary metals industries. The drives add a high-strength fabricated steel housing to the basic heavy duty shaft helical gear drive components, creating a unit that is capable of withstanding severe external impact, added to maximum performance.

The heavy, precision-machined steel bed of these drives keeps broad faced helical gearing in precise alignment to provide a smooth, overlapping mesh with close backlash tolerances. Tooth deflection is uniform under the heaviest loads. Heavy duty anti-friction bearings are conservatively rated to handle severest shock loads.

Available in nine combinations of shaft assemblies in single, double and triple reductions. Standard Ratios are from 208 to 1 and up to 360 to 1. Capacities to 1550 hp.



This is Martin-Activation

KEY TO MISSILE OPERATION

A New Division of The Martin Company

The Activation Division is organized to provide the facilities for the design, development, testing, and maintenance of check out and launch complexes for space vehicles and weapon systems bases throughout the world.

It offers to a select group of engineers an opportunity that is indeed unique in today's engineering specialities. It offers the challenge of not only devising a plan, but also of developing, testing, and seeing that plan put into operation.

Among the qualifications for the individuals we are seeking must be included the willingness to relocate, the desire to create and to participate in the developed end product operation. TO THIS TYPE OF MAN, MARTIN-ACTIVATION offers the opportunity for great personal advancement and recognition with a company which has proven technological ability.

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BUSINESS NOTES
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Temperature Chamber

A new packaged high and low temperature chamber which plugs into any 115 v power source has been introduced by Missimers Inc., 3737 San Fernando Rd., Glendale 4, Calif.

The firm says the new chamber was designed specifically to fill the need in testing laboratories for an inexpensive, small unit that will also maintain close temperature control. In addition to Mil-Spec qualification and reliability testing of small products or components, the chamber can be used for hot or cold treatment of metals, and for production processing and temperature stabilization of work.

Temperature range is from −100 to 350 F, using a hermetically-sealed, cascade refrigeration system, and a special heating system. Accuracies are controlled to ±3 deg F over the full temperature range, according to the company.

The unit, designated Model FT1-100X350, has a working space of one cubic foot, and outside dimensions of 35 in. wide × 24 in. deep × 45 in. high.

Construction features a stainless steel inner liner, welded to form a vapor barrier. Uniform temperature distribution is provided through an air circulation system, driven by an external motor.

Spray Atomizing Deaerator

Cleaver-Brooks Special Products, Waukesha, Wis., has introduced a new spray atomizing deaerator for marine applications.

The deaerator is designed to provide positive removal of dissolved gases in boiler feed water, preventing corrosion and assuring long boiler life.

Available in standard sizes with capacities from 15,000 to 1,000,000 lb of water per hour, the deaerator reduces oxygen content of effluent to less than 0.005 cc per liter.

Construction features include a steam atomizing valve with low pressure drop, permitting higher heating efficiency and higher water temperatures; two-stage vent condensing with final counter-flow for lower steam vent losses and superior oxygen removal; self-adjusting movable atomizing valve for consistently effective performance with varying inlet and varying load conditions; built-in check valve in atomizing valve to prevent back flooding.

Other features include full diameter stationary piston to absorb steam flow pulsation and provide protection for valve seat; stationary impingement baffle for absorbing impact of steam and water mixture allowing atomizing valve to respond freely and accurately to pressure forces only; straight line valve movement; standard components; and vertical water baffles radially positioned in conical water collector to insure even water distribution to the atomizing valve.

Steam Cleaning Hose

Raybestos-Manhattan, Inc., Passaic, N. J. announces its No. 200 BW steam hose, featuring braided steel wire burst protection designed for use to 200 lb saturated steam pressure at 388 F.

Steel wire braid construction gives unusual strength and flexibility and assures maximum safety, the company claims. Two braids of high tensile, multiple-end, noncorrosive steel wire are stretched over an asbestos covered innertube of thick heat resisting rubber. Minimum elongation and contraction under pressure, and longer hose life are also claimed for this construction.

Time-Cycle Controller

Bristol Co., Waterbury 20, Conn., announces an improved time cycle controller, Model C1C500, designed to provide increased flexibility for controlling processes based on timed operations.

The firm says the new instrument can time control as many as ten different variables for such applications as the operation of tire presses, dyeing, water condition, and batch processes.

Ten pilots—pneumatic, electric, or a combination—may be operated simultaneously or in any sequence. Each pilot can perform up to 24 operations. The pneumatic and electric pilots can be easily changed or added.

Dogs set on the periphery of the timing disk determine the timing of pilot operations. Intervals between operations can be as brief as 4 sec, and timing disks range from 0-15 to 0-360 min.

Variations of the basic model offer standard pneumatic pilots, high-capacity pneumatic pilots, spdt switches, dpdt switches, and special-purpose switches.

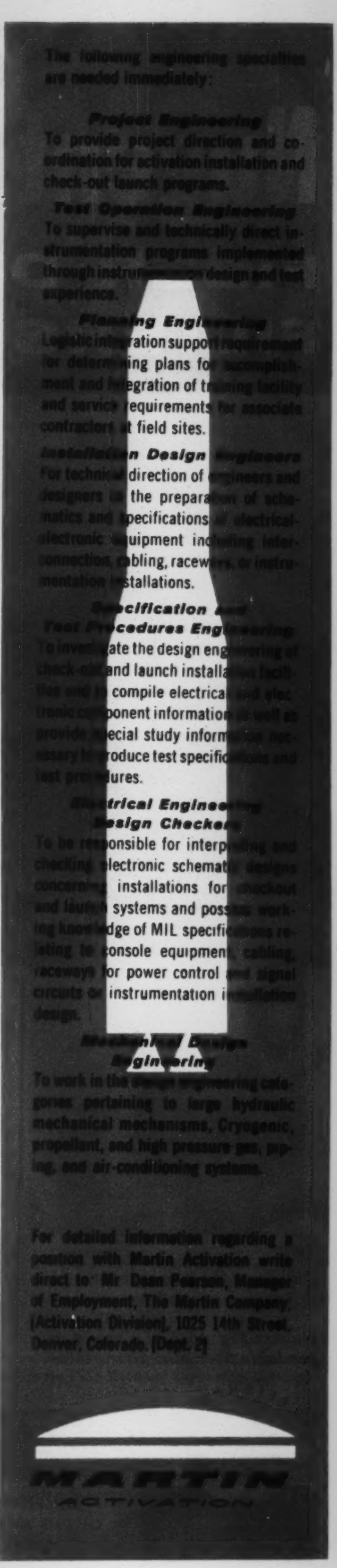
Revolving Handles

Revolving handles that attach to handwheels to simplify turning are now being produced by Jergens Tool Specialty Co., 712 E. 163rd St., Cleveland 10, Ohio.

The firm says the handles, made of aluminum, feature an extra long bearing surface to eliminate much of the turning friction, reduce wear and provide additional strength. As the hand-wheel is turned, the revolving handle grip spins on a steel stud attached at right angles to the hand-wheel.

The handle is attached by inserting stud at convenient location on wheel and slipping handle grip over stud. Locking ring assures positive fit, and the handle can be removed and reassembled as often as desired.

Use a CLASSIFIED ADVERTISEMENT
For QUICK RESULTS



The following engineering specialties are needed immediately:

Project Engineering
To provide project direction and coordination for activation installation and check-out launch programs.

Test Operation Engineering
To supervise and technically direct instrumentation programs implemented through instrumentation design and test experience.

Planning Engineering
Logistic integration support requirement for determining plans for accomplishment and integration of training facility and service requirements for associate contractors at field sites.

Installation Design Engineers
For technical direction of engineers and designers in the preparation of schematics and specifications of electrical-electronic equipment including interconnection, cabling, raceways, or instrumentation installations.

Specification and Test Procedures Engineering
To investigate the design engineering of check-out and launch installation facilities and to compile electrical and electronic component information as well as provide special study information necessary to produce test specifications and test procedures.

Electrical Engineering Design Checkers
To be responsible for interpreting and checking electronic schematic designs concerning installations for checkout and launch systems and possess working knowledge of MIL specifications relating to console equipment, cabling, raceways for power control and signal circuits or instrumentation installation design.

Mechanical Design Engineering
To work in the design engineering categories pertaining to large hydraulic mechanical mechanisms, Cryogenic, propellant, and high pressure gas, piping, and air-conditioning systems.

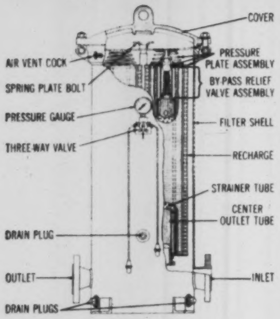
For detailed information regarding a position with Martin Activation write direct to: Mr Dean Pearson, Manager of Employment, The Martin Company, [Activation Division], 1025 14th Street, Denver, Colorado. [Dept. 2]

MARTIN
ACTIVATION

Nugent

FIBER DISC FILTERS

Full Flow Lube Oil Protection
for the RANGER III



Nugent Fig. 1555-4L4 uses 4 expendable fiber disc filter stacks.

The *Ranger III*, a luxurious 165 ft. passenger and freight ferry, plies the waters of Lake Superior between Houghton, Michigan and Isle Royale National Park. Twin Kahlenberg diesels equipped with Nugent Laminated Fiber Disc Filters power the new *Ranger*. These Nugent Filters (Fig. 1555-4L4) filter all the lube oil in circulation, every cycle, removing foreign solids as small as 5 to 10 microns. Oil is kept clean and harmful impurities cannot reach vital engine parts to accelerate wear.

Wouldn't your valuable equipment benefit from this type of filtration? For complete information on Nugent Disc Filters, write for Bulletin 7C.

ESTABLISHED 1897

WM. W. NUGENT & CO., INC.
3412 CLEVELAND STREET, SKOKIE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Fastener Tools

Two new fastener installation tools in the firm's Series 200 Pneu-Hydra line are now available from Huck Manufacturing Company, 2480 Bellevue Ave., Detroit 7.

Designated Models 285 and 287, the new single-action tools are of the pneumatic-hydraulic type which convert existing line (compressed) air into hydraulic pulling power by means of an integral power intensifier. The Model 285 has a rated pulling power of 7200-lb at 90 psi air pressure; Model 287 is rated for 10,000-lb pull at 90 psi air pressure.

Both Model 285 and Model 287 tools are recommended for use in installing full tension (AN bolt standard) Huckbolt fasteners from $^3/_{16}$ through $^3/_8$-in. diam in all materials. Each tool weighs $10^1/_2$ lb when equipped with a typical nose assembly; both tools are used with currently available standard nose assemblies.

Liquid Control System

OPW-Jordan, 6013 Wiehe Rd., Cincinnati 13, announces patented sliding gate and plate regulators for liquid level control, using plant air to pilot main diaphragm control valve.

The units are designed for tight shut-off and accurate control from 1 to 2500 gpm capacity. They are available in $^1/_4$ through 6 in. sizes.

Pressure and temperature ratings are bronze $^1/_4$–2 in., 250 psi, 406 F; cast iron 4–6 in., 125 psi, 450 F. The system uses plant air with $^1/_4$ in. needle valve and float valve to pilot main diaphragm control valve.

¼ HP Motors

Western Gear Corp., Electro Products Div., 132 W. Colorado Blvd., Pasadena, Calif., announces the design and manufacture of a new totally enclosed, self cooled, $^1/_4$ hp, 3300 rpm electric motor designed to conform to specifications CC-M-636.

The motor operates from 115 volts a-c, 60 cps, single phase electricity. It measures $4^1/_4$ in. in diam by $6^3/_4$ in. in length and weighs 10 lb.

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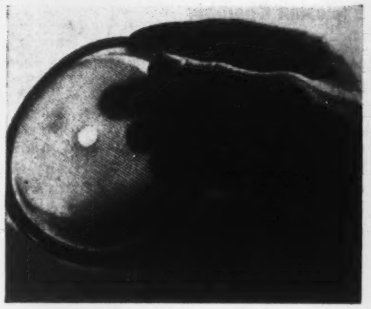


Diaphragm Seals

A new high-temperature long stroke rolling diaphragm seal for aircraft, missiles, rockets, and other control and regulator applications is now available from the Bellofram Corp., Burlington, Mass.

Designed to operate temperatures up to 550 F, the new seal is extremely thin walled and is claimed to offer maximum stroke, flexing life, and sensitivity.

The new seal is available in a range of elastomers, such as silicone compounds and Viton-A that can be combined with a special glass fabric overlay for maximum temperature protection over a wide range of physical and chemical requirements.

The firm says that because of the narrow convolution design of the high temperature seal, exceptionally high working pressures can be used in seal designs since only a small fraction of the applied pressure is experienced as fabric stress.

Standard sizes are available in 1 to 6 in. diam with a maximum stroke of up to 4 in. Four different classes of mounting configurations are available.

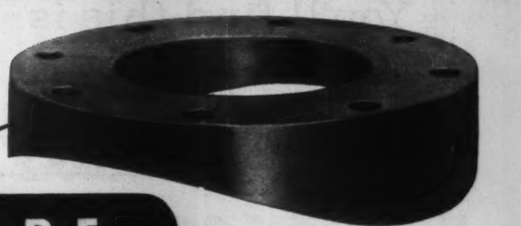
Gear Reducers

A line of standard gear reducers with mounting facilities to accommodate the firm's separate, coupling-connected standard NEMA motors of suitable horsepower, speed, and electrical characteristics has been announced by Lima Electric Motor Co., Dept 142, Lima, Ohio.

The gear reducers are available for horizontal foot mounted application, in either double or triple reduction units; double reduction units have a horsepower range of 1 through 125, with reductions from 230 to 45 rpm. Triple reduction units range from 1 to 50 hp, with reductions from 37 to 7½ rpm.

The reducers are equipped with Duti-Rated lifetime gearing claimed to give many times more wear life than ordinary gears of same size and weight. The reducers are also equipped with an exclusive spline drive pinion which permits quick ratio changes without complicated disassembly.

LOW SILHOUETTE



LENAPE

STUDDING OUTLETS

Lenape curved studding outlets or pads are compact in shape and provide inherent reinforcement of the vessel opening. Their low silhouette offers design as well as cost appeal, plus ease and economy of attachment. Use of a supplemental reinforcing ring is completely eliminated.

Important applications include interdeck access openings on small diameter towers or columns, boiler mountings, LPG tanks, clean-out or observation ports and similar uses in close-clearance locations.

Available in standard ID sizes from 1½" to 24" for ASA rated pressure service from 150 lbs. to 2500 lbs.

For detailed specifications, see pages 36-39 of Lenape Catalog 10-53, available upon request.

Compare the low silhouette of Lenape studding outlets with conventional long welding necks on this solvent trap.

See our standard line of pressure vessel connections on pages 1128-1129 in the 1958 Chemical Engineering Catalog.

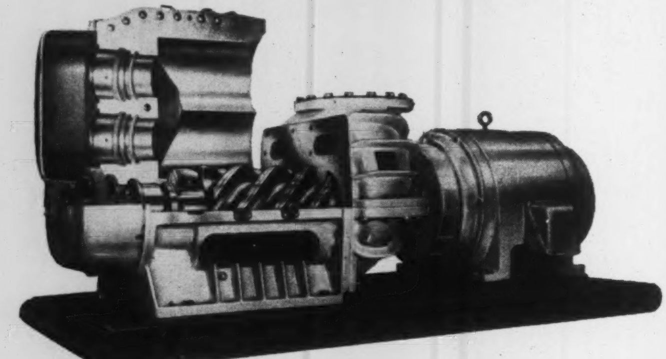
LENAPE
PRESSURE
VESSEL
CONNECTIONS

LENAPE HYDRAULIC PRESSING & FORGING CO.
DEPT. 114 WEST CHESTER, PA.
RED MAN PRODUCTS

You'll find this is

the only rotary compressor

with all these features!



Fairbanks-Morse Positive Displacement Axial-Flow Rotary Compressors are available in standard models in single-stage units, with capacities from 800 to 12,500 cfm. at compression ratios from 1.6:1 to 5.0:1—or in two-stage units with capacities from 2,000 to 12,500 cfm. at compression ratios above 5.0:1—and for booster service at maximum working pressures up to 250 psig.

- **High efficiency and stability** that rivals reciprocating machines.
- **Low weight and small space** requirement that cuts costs for installation, foundation and building.
- **Oil-free output**—no metal-to-metal contact of impellers or casing, no lubrication of parts contacting gas, air or vapor.
- **Mechanical simplicity**—no valves, no pistons or reciprocating parts to wear or replace.
- **Adaptability to any power source** permits choice of induction or synchronous motor, diesel engine, gas or steam turbine as prime mover.
- **Smooth, steady operation**—impeller speed and design produce even delivery of flow with minimum pulsation or vibration.

For complete information contact your nearby Fairbanks-Morse Branch, or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill. Ask for new Bulletin ACO 100.2.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

COMPRESSORS • PUMPS • SCALES • DIESEL, DUAL FUEL AND GAS ENGINES
LOCOMOTIVES • ELECTRIC MOTORS • GENERATORS • MAGNETOS • HOME WATER SYSTEMS

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Explosion Chamber

A new explosion test chamber featuring a simplified fuel measuring system has been announced by Missimers Inc., 3737 San Fernando Rd., Glendale 4, Calif.

According to the firm, the chambers are designed to perform tests required under MIL-E-5272A and MIL-E-005272B, for components or products which must operate in an explosive atmosphere, and for testing explosion-proof enclosures.

The new chamber meets ASME pressure vessel code requirements. Altitudes up to 85,000 ft can be simulated for use with or without explosion tests.

Safety features listed include a quick-acting chamber door which seals the full explosive force, and which controls an interlock switch to insure full door closure before the firing circuit can be energized. Two other safety interlock switches prevent firing unless the fuel feed and vacuum pump valves are closed, and a remote firing button can be supplied.

The firm pointed out that the units can be used with either commercial butane or aviation gasoline, and can be adapted to other fuels.

Gate Valves

Ohio Injector Co. has released an eight-page brochure covering a new line of gate valves designed specifically for ductile iron.

The new valve line which will be known as the Pipe-Pal series, introduces an innovation described as the spread flange design which features a high visibility bonnet joint and extra long bolts for storage of bolting energy. In addition to listing complete specifications, pressure-temperature ratings, and dimension and material charts, the folder describes newly developed applications for the ductile iron lines.

Batchboard Control

A new and advanced method for automatic batching control has been introduced by Toledo Scale Div., Toledo Scale Corp., Toledo 12, Ohio.

The development, referred to as Batchboard Remocon control, is said to afford proportioning control opportunities through automatic presetting of unlimited numbers of batch formulas. It eliminates the necessity for manual adjustment of individual weight selectors to obtain the desired quantity of each ingredient in the batch.

Each batchboard is approximately 7 × 10 × 2 in. and contains contact holes, each hole representing a weight value. Plug wires are inserted into the appropriate holes to set up the desired batch weight of each ingredient for single or multiple scales. An individual batchboard is used for each formula, and once the unit is wired, it can be used indefinitely without rewiring. Each unit is enclosed to prevent accidental change to the wiring.

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BUSINESS NOTES
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Hydraulic Press

A 150-ton electric hydraulic press has been introduced by the ACCO Equipment Div., American Chain & Cable Co., York, Pa.

Frame members of the press are fabricated from high grade structural steels. This frame assembly is of all-welded construction. All corners have been coped and ground to eliminate sharp edges and disagreeable contours.

Its ram, manufactured from solid bar stock 8620 steel, is heat treated and ground to obtain a 16 micro-inch finish. It has a hard outer case of Rockwell 060 and an inner body which is capable of resisting severe hydraulic shocks.

Easy and fast contact between the ram and work is made possible by rotating a hand wheel which has been geared to a square-thread, ram-extension screw. The firm says this permits rapid approach to the work, makes the contact necessary for proper positioning, and reserves the full power stroke for the work to be performed.

The work table which is fabricated from structural steels, is of all-welded construction. It is supported by six hardened steel pins. This table is moved through a wide range of travel by a worm gear-reduction winch. The winch is self-locking and has a sealed lubrication and gear train system for greater safety. Its aircraft cable suspension is equipped with coil springs to prevent shock from being transmitted from the table to the suspension system.

Motor-Generators

Kato Engineering Co., Mankato, Minn., announces motor-generator units with controls which have an output frequency of 800 cycles.

The units supply power for numerous 800 cycle applications including high frequency lighting and intricate electronic control systems. The higher frequency permits the use of smaller electronic components such as motors, starters, filters, and chokes.

The firm says the 60-cycle Synduction drive motor retains precise speed regardless of load changes on the alternator. The 800-cycle generator is rated at 5 kva, 120/208 v, 3 phase, 4 wire. It is of the revolving field type, has 40 poles and produces an output frequency of 400 cycles at 2400 rpm. The speed reducer, direct connected between the two machines, permits the motor to operate at a slower speed of 1200 rpm.

Use a
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TRAPS ALMOST 4 CU. FT. OF DUST PER WEEK

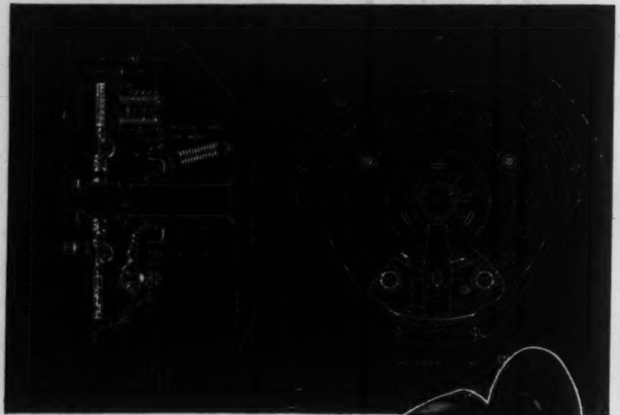
One small Pangborn Dust Control system replaces 8 collector units profitably at Precision Rubber Products

At Precision Rubber Products Corporation, Dayton, Ohio, millions of seals pass through a buffing process every year. The resulting dust could constitute an operating and housekeeping hazard. To facilitate dust control, the company replaced eight individual collector units with a central Pangborn Dust Control system. This installation saves floor space, operates quietly and gives efficient dust control (trapping almost 4 cu. ft. of rubber dust per week). Dust is now removed from *one* collector hopper instead of eight individual hoppers.

If dust is a problem in your plant, talk to the Pangborn man in your area or write PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment—Rotoblast® Steel Shot and Grit.*

Pangborn CONTROLS DUST

ROCKFORD



Design and Stay With the Genuine

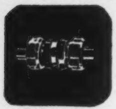
ROCKFORD CLUTCHES provide the advantages of heat-treated, hardened and ground steels—flat, non-grab facings—heat dissipation—dirt exclusion—and fine adjustments. Only ROCKFORD provides clutch levers that reduce friction, improve release action and prevent lever throw-out. These wear-resisting, life-lengthening clutch features are essential to designs that must be projected with a thought to uses of tomorrow. ROCKFORD engineers now are working with many companies on their future designs—to provide custom-engineered clutches for long range economy. Their services are available to you.

See us in Booths No. S-1 to S-16 at the Milwaukee S.A.E. Convention

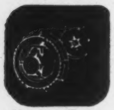
Small Spring Loaded

Automotive Spring Loaded

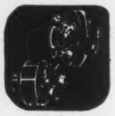
Heavy Duty Spring Loaded



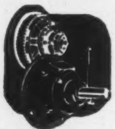
Oil or Dry Multiple Disc



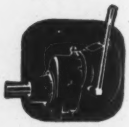
Heavy Duty Over Center



Light Over Center



Power Take-Offs



Speed Reducers

SEND FOR THIS HANDY BULLETIN

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD Clutch Division BORG-WARNER
1307 Eighteenth Ave., Rockford, Ill., U.S.A.
Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

ROCKFORD
B-W
BORG-WARNER

CLUTCHES

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Turning-Boring Machine

A numerically controlled, double spindle turning and boring machine is claimed to precision machine inside and outside contours of hemispheres, cylinders, and other related metal parts with infinite variations from a hemispherical contour to a repeatability of 0.0001-in.

The two-axis numerically controlled machine tool system was designed and built cooperatively by Heald Machine Co., and Industrial Controls Section, Bendix Aviation Corp.

Adapting numerical control to this single point, 2-axis turning and boring machine makes possible machining to a tolerance of ±0.0001-in., the firms state. In many instances, tolerances of ±0.000070-in. are achieved to maintain critical inside and outside diameters. The Bendix numerical control system provides a command pulse value to each of the two machine slides of 0.000025-in. or 40,000 pulses per inch of slide travel.

In operation, one spindle of the machine tool is used to machine the outside diameter and the other spindle is used to machine the inside diameter of the part. Only one spindle at a time is operated on this machine.

The work piece is clamped in a rotating fixture attached to the spindle. A single point tool, which is mounted on two hydraulically operated slides, is numerically controlled in two axis (longitudinal and transverse) to machine the desired part shape to extremely close tolerances.

Linear Conversion

A linear conversion table for reference by those who have occasion to convert inches and fractions of inches into decimal parts of a foot has been issued by Tubular Products Div., Babcock & Wilcox Co.

Control Connectors

A new series of equipment control connectors of high durability and safety, for applications up to 600 v, has been developed by Joy Mfg. Co., Electrical Products Div., 1201 Macklind Ave., St. Louis 10, Mo.

The company says the connectors are constructed of Neoprene, and are crush proof, corrosion proof, water proof, and dirt proof. Molded-to-cable design is claimed to allow severe or repeated flexing without breaking connector-to-cable bond. The connectors are available in three basic styles; oval, round, and dual round—from 2 to 12 poles.

Receptacle units are designed to fit standard types of outlet boxes common to factory wiring installations. Round series fits all standard FS and FD boxes. Hinged receptacle cover locks portable connector firmly in place when fully engaged.

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Low Temperature Pump

Standard Pump Div., Worthington Corp., has introduced a special pump for handling low temperature liquids, such as liquid oxygen, at −297 F.

The firm says the pump is a standard pump with special modifications to enable it to provide severe, low temperature service.

Selector Switch Assemblies

A new series of rotary selector switch assemblies featuring a cock-and-fire actuating mechanism and nontease circuitry has been introduced by Micro Switch Div. of Minneapolis-Honeywell Regulator Co.

The "28AS" series assemblies are designed for use on aircraft, electronic, and computer panels, and other areas where mounting surface is at a premium. They can be provided with two to eight plastic-enclosed single-pole/double-throw basic switches and two or three actuator positions. Detents are 90 deg.

While moving positively from one position to another, the actuating mechanism imparts a good feel of the detent action, the company said, and provides immediate indication of each position in the operating cycle.

A variety of switching sequences can be factory adjusted to fit customer requirements. Individual actuating levers pivot on a common rod, insuring maintained adjustment. The levers are operated by precision cams which are rigidly mounted on the actuator shaft in the desired operation sequence.

The cams are fabricated of permanently lubricated, laminated phenolic. They have been tested and qualified to meet the fungus test requirements of MIL-S-6744.

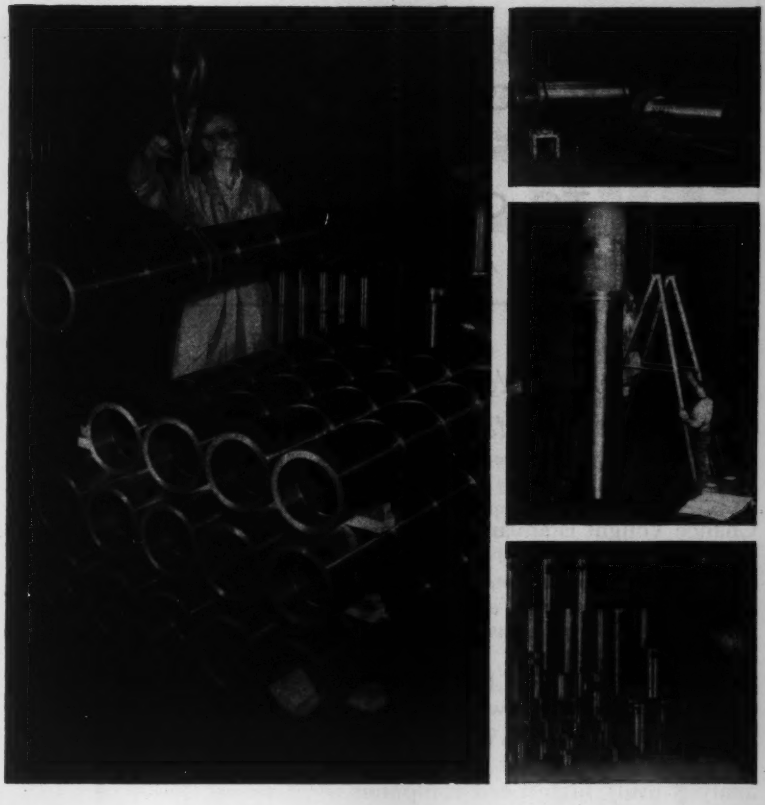
A variation is available with a stainless steel dust cover over the assembly to prevent foreign objects from lodging between the camshaft and the basic switches. Turret solder terminals are standard, but plastic-covered leads embedded in epoxy can be provided.

Conveyor-Loading Feeder

A conveyor-discharge trough feeder, designed to reduce spillage of material in feeding onto moving belt conveyors and to facilitate the concentration of material onto the center of the conveyor to prevent loss in transit, is announced by Syntron Co.

The feeders, of the heavy capacity classification, are designed to feed heavy, hard-to-handle bulk materials such as chemicals, coal, rock, feeds and grains, and heavy construction materials at easy, stepless, variable rates of feed.

They feature 3600 electromagnetically produced vibrations a minute. Their power of vibration is instantly variable to provide continuous, stepless feeding rate adjustments from 0 to 100 per cent capacity, the company reports.



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SHENANGO CENTRIFUGAL CASTINGS

By using Shenango centrifugal castings for essentially symmetrical parts, you will gain considerable savings because:

① **The Shenango process automatically eliminates hidden defects in the metal . . . insures fewer rejects.**

② **No patterns required . . . an important saving, particularly on special or small quantity runs.**

③ **Finer. more uniform grain structure means smoother, faster machining, better control, and a higher rate of completion.**

④ **With Shenango centrifugal method control, there's less excess metal to be machined away, less metal to buy and ship!**

⑤ **Because of their homogeneous, pressure-dense qualities, Shenango centrifugal castings are stronger, have better wear resistance and require less frequent replacement. Maintenance cost is cut!**

Check with Shenango on centrifugally cast parts for your needs—large or small castings . . . rough, semi-finished or precision-machined . . . ferrous or non-ferrous. They'll cost you less in the long run. For bulletins, write to: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS

NEW VOUGHT PROJECTS
OFFER CAREER APPEAL
TO CREATIVE MEN

exploratory work in wide variety
on new metals, methods and weapons

Chance Vought is advancing on many fronts. In *Astronautics* there is development of the 4-stage "Scout" research rocket for NASA. In *Antisubmarine Warfare,* detection and classification studies for the Navy. In *Advanced Weapons,* hypersonic systems are in development. *Electronics* for weapons – and for advanced control systems – are being developed by Vought. The company's Range System Division is managing key missile ranges. These activities have prompted exploratory work in the following areas:

Structures (Supersonic and Hypersonic)
Heat transfer, thermal stress and deflection analysis, and stress analysis using high-speed computers.

Manufacturing R & D
Welding and brazing of super alloys and exotics; advanced forming and cutting studies; prediction of metal fabricability.

Industrial Engineering
Project estimating, work sampling, line load and balance, and packaging and installation of new procedures.

Antisubmarine Warfare
Studies of detection and classification techniques involving Acoustics, Geomagnetism, Geophysics, Electromagnetics, Electrochemistry, Math.

Engineering Planning
Man-hour and budget forecasting, and project planning and scheduling.

Structures Materials
Advanced metallurgical analysis of exotic materials. High temperature studies. Refractories, ceramics. Fusion welding of precipitating hardening stainless steels and tool steels.

Flight Test Instrumentation
R & D in new techniques for electronic gathering and reducing of flight test data.

Aerodynamics
Wind tunnel and model work employing Vought's 3,800-mph high-speed wind tunnel and new "high-temperature" laboratory.

Qualified applicants are invited to write:

Engineering Personnel
Dept. T-8

AERONAUTICS ASTRONAUTICS ELECTRONICS GENESYS CORP. RANGE SYSTEMS RESEARCH

CHANCE VOUGHT
DALLAS, TEXAS

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Expands Fitting, Valve Line

Major expansions and improvements in availability and packaging of valves and fittings for copper and brass pipe and tube are now being instituted by Chase Brass & Copper Co.

Plans include an immediate addition of approximately 200 new items to the firm's present line, including additional types and sizes of wrought and cast solder joint fittings, drainage fittings, valves, and tube staples. In addition, wrought fittings in sizes through 4 in. and cast fittings in sizes through $1^{1}/_{2}$ in. will be packed in boxes instead of plastic bags, for protection and easy identification and storage.

Lock Spindle Rivet

A lock-spindle blind rivet, fabricated in a new combination of materials claimed to give substantially improved strength characteristics at all temperatures up to 1000 F, is now available from Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7.

Designated the MLS blind rivet, the factory-assembled 3-piece fastener consists of a monel sleeve, a pin of 17-4PH stainless steel alloy and a monel locking collar. It is being produced in $^{1}/_{8}$, $^{5}/_{32}$, and $^{3}/_{16}$-in. nominal sleeve diameters.

Head styles are protruding (AN 470 rivet head) and 100-deg AN427 countersunk. All sizes are available in $^{1}/_{16}$-in grip (sleeve length) increments, which the firm says, results in a broader grip range to meet a wider variety of application requirements. The grip increment is marked on every fastener.

The company reports that the fastener was especially developed for use in stainless steel and high alloy applications. It provides corrosion resistance and exceptional strength at elevated temperatures. No plating or special treatment of the rivet is necessary.

Air Hose Coupling

A new automatic coupling device that, according to the manufacturer, provides the fastest, most efficient method available for coupling and uncoupling air hoses, has been announced by Lincoln Engineering Co., 4010 Goodfellow Blvd., St. Louis 20, Mo.

Called the Flex-O-Matic coupling, the new product is offered in four sizes, for $^{1}/_{4}$, $^{3}/_{8}$, $^{1}/_{2}$, and $^{3}/_{4}$ in. id hose. The firm says no tools are required to couple or uncouple the new couplings. A straight push connects the plug, locking it firmly in the socket regardless of air pressure. A slight pull on the knurled sleeve disconnects socket and plug, automatically shutting off air.

A precision-fitted seal prevents leakage, and swivel action of the plug in the socket prevents kinking of the hose, the company reports. Air passage through the new coupling is unrestricted.

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Filter Combination

A new filter combination, Model 032670, for particle control down to 2 μ in high performance missile and aircraft support equipment, is available from Bendix Filter Div., Bendix Aviation Corp., 434 W. 12 Mile Rd., Madison Heights, Mich.

The new filter combination consists of a 10-μ prefilter and a double bowl 2-μ fine filter. Liquid flow for the combination is rated at 20 gpm. Operating temperatures range from − 65F to + 275F.

The prefilter of the new combination contains a Micropleat disposable filter element. Pleated configuration of this element permits maximum filtration area for the envelope size. Microedge elements are used in the fine filter portion of the combination assembly. These are cleanable, non-collapsable elements.

Heads and bowls of the new filter combination are made from aluminum bar stock. Both the prefilter and the fine filter portions of the assembly have differential pressure indicators to signal the need for element servicing. With clean fluid, the pressure drop across the elements, housings and fittings of the combination is less than 40 psi with 20 gpm of MIL-O-5606 at 160 F.

Vibrating Feeder

Jeffrey Mfg. Co., Columbus, Ohio, has added a new heavy duty feeder to its line of electric and mechanical vibrating units.

This No. 6-D feeder was designed with a capacity up to 1000 tons per hour for feeding controlled tonnages from bins, hoppers to belt, crushers, pulverizers, kilns, grinding mills, scales, and other processing equipment.

The unit is equipped with 60 × 90 in. open pan deck and renewable wear resisting liner. It can be furnished with various deck styles: enclosed pan, tubular decks, grizzly type deck or with spreader-type deck.

Servo Component Clamp

Precision Mechanisms Corp., 577 Newbridge Ave, East Meadow, N.Y., announces a new clamp, Part No. 2014 for mounting motors, potentiometers, synchros, and other types of servo style components.

The clamp is available in two sizes which accommodate a broad range of rotating shaft units. The unit has a unique slotted design which provides easy engagement and broadens the area in which the hold-down screw may be placed.

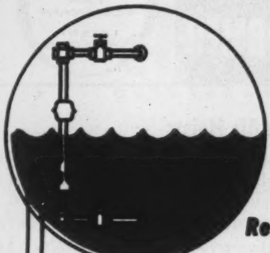
The wedge shape and use of 18-8 corrosion resistant steel provide an unusually high holding capacity, the firm reports. Requirements of MIL-E-5400 are fulfilled.

Know all your water levels—*every minute*—

with the help of

Reliance

EYE-HYE®



Remote indication saves time—increases safety

Any water-containing vessel is a potential hazard, whether it's fired or unfired. For most efficient control, *gages for all vessels should be out in the open, or at control stations.*

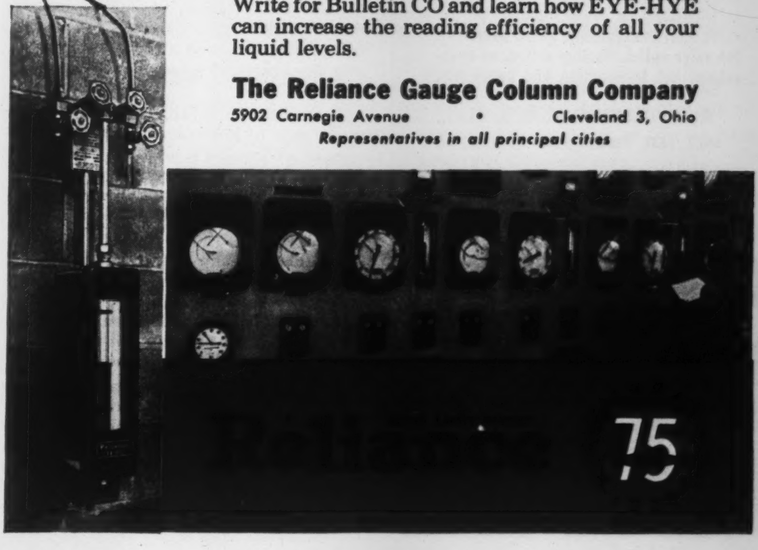
Where remote reading gages should be used:

Stationary power boilers
Feed water heater tanks
Waste heat boilers
Surge tanks
Water treatment systems
Heating boilers
Storage tanks
Marine power boilers

What you should expect in a remote reading water level indicator	Reliance EYE-HYE
Flexibility of placement. Gage reading precisely where most convenient to use — even above the boiler.	✓
Sharp visibility. Easy to read green indicating fluid, illuminated.	✓
Scientific accuracy. U tube manometer principle for laboratory exactness.	✓
Simplicity. Smooth hydrostatic action — no mechanical working parts.	✓
Safety. Invites frequent reading — an aid to preventing water level accidents.	✓
Easy installation. Flexible tubes from boiler to gage window.	✓
Low maintenance. Scheduled cleaning only at infrequent intervals. Easy to blow down.	✓

Write for Bulletin CO and learn how EYE-HYE can increase the reading efficiency of all your liquid levels.

The Reliance Gauge Column Company
5902 Carnegie Avenue • Cleveland 3, Ohio
Representatives in all principal cities



CASH-ACME . . . meeting pressure control needs for product design engineers everywhere

Type Vacuum Regulator Valve D-51

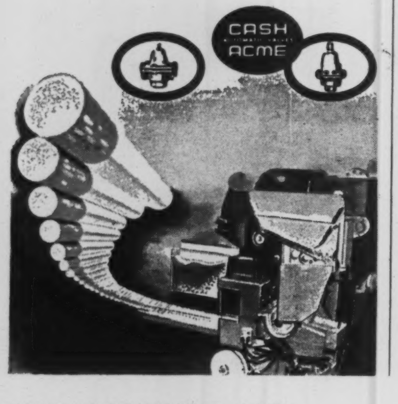
CASH-ACME VACUUM REGULATOR VALVE PREVENTS CIGARETTE JAM IN NEW FILTER TIPPING DEVICE

To keep pace with fantastic demands for filter tipped cigarettes (now 40% of the market), manufacturers are attaching a new kind of tipping device to machines—capable of tipping 780,000 cigarettes in a 10-hour run

Designers give a lot of credit for the device's amazingly foolproof performance to Cash-Acme engineers An extremely exact "low whisper" vacuum must be maintained at all times... just enough to hold the cigarette while the filter is affixed. This is assured by strategic placing of Cash-Acme Regulator Valve D-51 on the machine's vacuum line which brings high vacuum from the plant's central system. By regulating and keeping the vacuum at the proper level, all chances of "jamming" and production loss are eliminated.

TYPE D-51 VACUUM REGULATING VALVE Ready for exacting vacuum regulating jobs on any type of equipment. Type D-51 is expressly designed for use in systems where it is desired to maintain, automatically, a lower vacuum at the valve inlet than prevails at the source on the valve outlet. No step-action, no snap-action, but full-floating and automatic.

A. W. CASH VALVE MFG. CORP.
6627 East Wabash Ave., Decatur, Ill.



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Portable Air Hoists

Ingersoll-Rand Co. has developed two new light-weight, portable, air hoists, designed to be easily moved and installed by one man.

The 1000-lb capacity hoist weighs 39 lb and lifts its rated load at 45 fpm. The 2000-lb hoist weighs 56 lb and lifts its rated load at 22 fpm.

The hoists are streamlined in appearance with a lightweight, aluminum alloy housing which measures $12^1/_2$ in. in overall length, $5^1/_4$ in. in diameter and takes up little headroom. According to the company, the Size MR and ML hoists have application in tool and die shops, foundries, forge shops, machine shops, machine tool plants, assembly lines, plant maintenance, and shipping and receiving departments.

Several unique features are designed to provide safety for the operator and easy control of the hoist. A mechanically operated brake is automatically applied whenever the controls are released. If the air supply should be shut off, the lowering of the load may be controlled by the brake. Safety-up-and-down stops prevent damage to the hoist from overrun of the chain in either direction.

Engine Control

AC Spark Plug Div., General Motors Corp., Milwaukee, announces the Speed Monitor, a compact engine control device weighing 1 lb and with an accuracy of within $^1/_2$ per cent of speed setting.

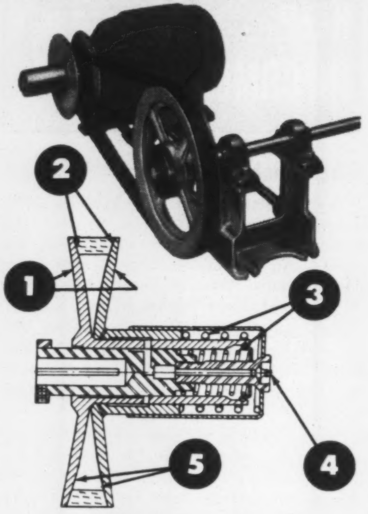
The device is essentially a flyball type governor in that it contains flyweights resisted by calibrated spring force. The firm says instant response to engine rotation is obtained by the extreme accuracy with which the flyweights are calibrated. Their centrifugal force becomes a thrust on an actuator that operates two snap action electrical switches.

The monitor is capable of operating in a speed range of 500 to 5000 rpm at temperatures of −65 to 250 F with a life expectancy of over 2000 hr. Permanently lubricated and ignition proof, it is not affected by altitude or attitude, sand, dust or fungus, the company reports.

When more than two switches are desired, or when the settings are in different speed ranges, two monitors can be coupled in tandem. Only one pad location is required. The monitor also provides for mounting a tachometer generator in the same fashion.

Designed to meet requirements of MIL-E-5009A it can be calibrated to meet exact requirements for such applications as engine starting cycle control, ignition and ignition cutoff, engine starter cutoff, clutch control, afterburner arming, overspeed and underspeed protection, and entrance guide vane positioning.

feature by feature...



INDUSTRY'S MOST EFFICIENT VARIABLE SPEED PULLEY

1 Both sides of the driving disk open simultaneously and equally to give constant belt alignment.

2 Power is transmitted through sides of the belt to a grooved sheave to insure maximum efficiency and prevent slippage.

3 Each side of the driving disc is independently actuated by its own spring, eliminating ratchets, cogs, gears or other moving parts subject to constant maintenance and wear.

4 Oilite bronze bushings on fractional hp. units provide life-time lubrication.

5 Curved pulley faces maintain full contact with belt sides at all times, greatly increasing overall efficiency.

Pulleys are available in a complete range of sizes, fractional tc 15 hp.—full 3 to 1 ratio. Immediate delivery from stock.

Request recommendations for your application. Ask for Catalog P-58.

Lovejoy *FIRST NAME IN VARIABLE SPEED PULLEYS*

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Hinged Closure

Addition of a line of one-man hinged closures with built-in safety features to its list of piping components has been announced by Tube Turns Div., Chemetron Corp., Louisville, Ky.

The company says the new product line, already widely used in vacuum, low- and high-pressure services in the petroleum, gas transmission and chemicals industries, was acquired from Sweco, Inc., Houston. It is now being produced and stocked by Tube Turns.

The new closure is a complete assembly consisting basically of a hub that is installed with a single circumferential weld and a hinged cover or cap that is readily clamped within two yoke halves. The hinge is an integral part of every closure. Sizes 8 in. and larger, furnished with two yoke bolts that spread the yokes simultaneously, cannot be opened inadvertently in the presence of pressure, the firm says.

The company is producing the hinged closure in sizes from 2 through 42 in. for ASA 150, 300, and 600-lb service, with larger sizes and other pressure classes available on special order. Counterbalanced spring-loaded types are offered for vertical applications in sizes 18 through 36 in. for ASA 150-lb service.

Performance Meter

A performance meter for multi-cylinder diesel, gas, steam, and gasoline engines designed to permit rapid adjustment and balancing of cylinder loads of the engine, and measurement of power output has been announced by Korfund Co., Inc., 48-35N 32nd Pl., Long Island City 1, N. Y.

The instrument, called the Pi-Meter, can be quickly attached to a cylinder's pressure tap. It reads time-averaged pressure which is related to indicated mean effective pressure. This pressure (psi) is read directly on the meter's dial while the engine is running. Five different springs within the instrument will accommodate a wide enough pressure range to adapt it for use with any type of reciprocating engine, the firm states.

Damping Attachment

A new damping attachment developed by Square D Co., 4041 N. Richards St., Milwaukee 12, eliminates contact transfer or telegraphing which might result from limit switch arm snapback.

Designed for use on any of the firm's Type A oil-tight limit switches, the new damping attachment also increases total travel of the arm from 30 to 120 deg. The attachment can be used with any arm. Typical applications include conveyors and automation equipment where precise actuation by means of a cam is not practical.

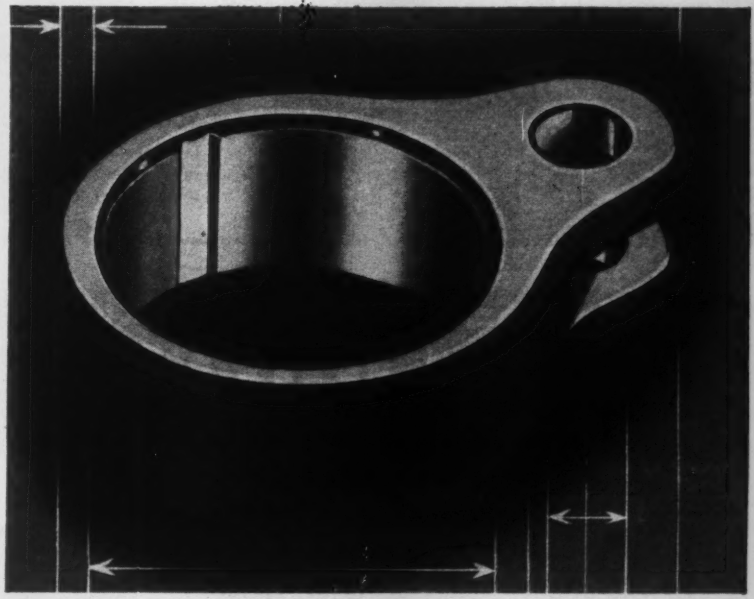
exceptionally close limits...

The photograph shows the connecting rod of an unusual hydraulic pump built by a company whose name is known everywhere.

The finish in the bore of both the large hole and the small hole must be held to very fine profilometer reading.

In addition, the axes of these two holes must be parallel to each other within exceptionally close limits. Naturally, the user of a cast bronze part such as this turns to Bunting in order to assure strictest adherence to his print and specifications.

For the unusual, as well as the usual, in bearings, bushings, bars, or special parts of cast bronze, sintered bronze, or Alcoa aluminum, try Bunting first.



BUNTING SALES ENGINEERS in the field and a fully staffed Product Engineering Department are at your command without cost or obligation for research or aiding in specification of bearings or parts made of cast bronze or sintered metals for special or unusual applications.

...ask or write for your copy of...

Bunting's "Engineering Handbook on Powder Metallurgy" and Catalog No. 58 listing 2227 sizes of completely finished cast bronze and sintered oil-filled bronze bearings available from stock.

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Globe-type valve for lines from 3" to 24"

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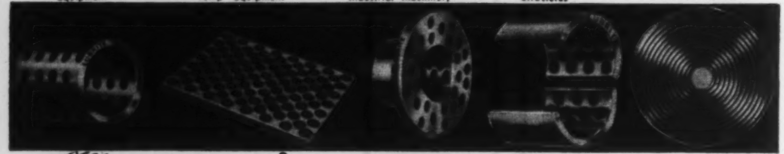

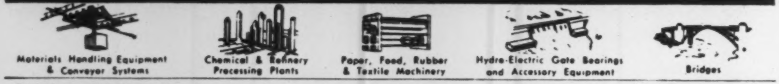
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Lubrite self-lubricating bearings offer great versatility in hundreds of fields where dependability and superior performance are of prime importance.

Lubrite Bearings, with clean, permanent, maintenance-free self-lubrication are designed to withstand severe loadings, temperature extremes, submersion, corrosion and other adverse conditions.

Lubrite may be just the bearing you need in your designs to obtain better results.

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BUSINESS NOTES
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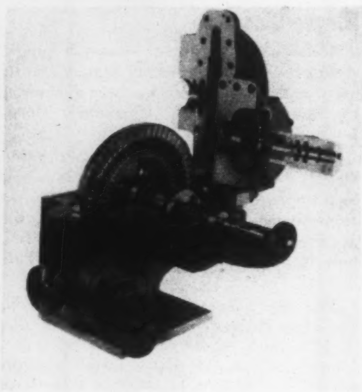
LATEST CATALOGS



Gas-Expanding Turbine

Dean Hill Pump Co., Indianapolis, Ind., has announced production of a gas-expanding turbine, Type GET, which is said to be unique in small turbine design in that it is fully reversible.

The turbine can also be supplied with one row of blades for nonreversible operation. Applicable to gas pipeline valve operations, the unit is designed for 1 to 45 hp, with 1000 psig maximum inlet pressure. A mechanical speed governor, manual speed changes, and an overspeed trip valve are standard.

A forged, one-piece, two-row blade permits reverse rotation when gas or steam is directed against one or the other row of blades. Two hand-formed nozzles assure proper gas or steam expansion, and are located to activate either row of blades. A safety overspeed trip valve is actuated at a predetermined speed of 12,000 rpm.

Material Intake Valves

A variety of new material intake valves which can be used with all types of high vacuum pneumatic systems employed in the removal or transport of dry, free flowing, powdery, or granular materials from hoppers, bins, and dust collectors, are now available through the U.S. Hoffman Machinery Corp., Dept. EM, 103 Fourth Ave., New York 3.

The new valves are suitable for use on 2 through 6 in. pipe lines and come equipped with standard 8-in. flanged connections which permit simple and rapid installations on any bin, hopper, or collector.

While air is flowing, the rate of material intake can be adjusted, the firm reports. A separate air inlet prevents connected equipment from exposure to full suction of the vacuum system.

For Consulting Engineers
Turn to Page 182

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Packaged Elbow Fans

A new design of elbow fan for general ventilation and for use with such equipment as furnaces, dryers, ovens, kilns, and plating and pickling tanks, has been introduced by L. J. Wing Mfg. Co., Linden, N. J.

Standard units are designed to handle clean or slightly contaminated air or fumes at normal or elevated temperatures. Special construction accommodates corrosive or explosive conditions.

Installed in ductwork, the unit occupies only slightly more space than a standard elbow. A choice of three inlet connections is provided. The firm says the dynamically-balanced fan wheels have true airfoil blade profiles for high efficiency with minimum turbulence, vibration, and noise. Flat horsepower characteristics prevent motor overload even at full dampered shutoff.

The elbow fans are available in five basic sizes with a choice of motors, for capacities from 600 to 32,000 cfm at static pressures to 2 in. or more. Standard fans can handle up to 750 F. Higher temperatures can be accommodated by admitting diluting cooling air, the company states.

Manganese-Bronze Alloy

Development of a new extruded manganese bronze alloy for long-wearing application in bushings, gears, cams, shafts, and connecting rods has been announced by Ampco Metal, Inc.

The new alloy, named Ampcoloy 666, is produced entirely from virgin metals and is extruded from continuous-cast billets. The alloy has excellent bearing characteristics, good machinability and high resistance to wear and corrosion, the company reports. It is supplied from stock in a number of diameters in standard mill lenghts or cut to customers requirements.

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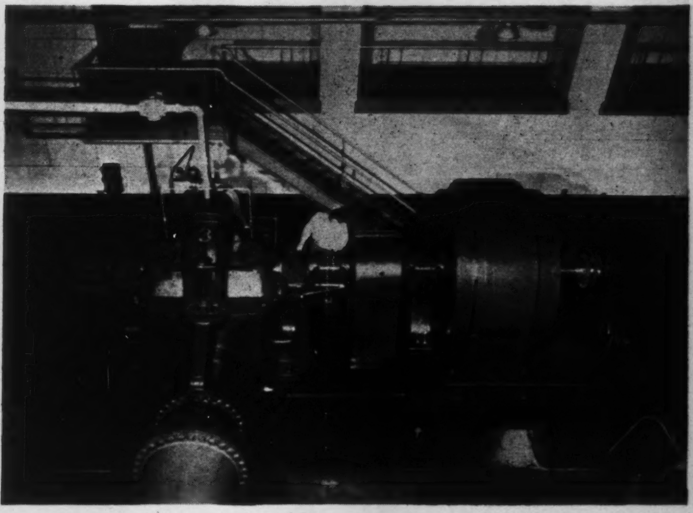
BLOOD BANK • TRAINING PROGRAMS

A case for F-M Split-Case Centrifugals!



Typical installation in Toledo averages 80.314% wire-to-water efficiency for year!

Exceptionally high and dependable efficiency with steady, low-cost operation year after year—that's the report from a host of municipalities and industries using Fairbanks-Morse pumps in their pumping stations.

Why? Ask stations like Collins Park High Service in Toledo, O., where five Fairbanks-Morse 36-in. Split-Case Centrifugal Pumps have been giving superb performance for 17 years. The No. 3 pump in the photo pumped 6,065,590,000 gallons in one year alone, handling 26.13 percent of the plant total, and consuming just 3.55 kilowatts hours per million foot gallons!

Your Fairbanks-Morse Field Engineer welcomes you to inspect many other reports like this from his files—reports revealing why no other manufacturer can match the experience of Fairbanks-Morse in providing pumps and drivers for both municipality and industry. Your F-M Field Engineer will be glad to work with your own engineers in selecting the best equipment for your specific requirements. Write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

See Sweet's Product Design Catalog File for complete F-M Pump Line.

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a name worth remembering when you want the BEST

PUMPS • SCALES • ELECTRIC MOTORS • DIESEL, DUAL FUEL AND GAS ENGINES
LOCOMOTIVES • COMPRESSORS • GENERATORS • MAGNETOS • HOME WATER SYSTEMS

Make your next connection with

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UNIVERSAL JOINTS

They are made to provide smooth, more efficient transmission of power and are available from stock in 13 sizes with bored or solid hubs ranging from .375" to 4.000". Special bores, bores with keyways or setscrews are available upon special order.

The close limits to which all parts are held assure maximum load carrying capacity with durability and long life. All parts are made of preheat-treated alloy steel and are precision ground to insure high quality and interchangeability of components. Joints with hub diameters of .750" and larger have a self-closing snap ball oiler while the small pin is held in place with a self-locking snap ring. The snap ring simplifies assembly and disassembly.

Send today for Bulletin No. 527 describing the full line of ASG Universal Joints available from your nearest distributor.

AMERICAN STOCK GEAR DIVISION
PERFECTION GEAR COMPANY **HARVEY, ILLINOIS, U.S.A.**

KEEP INFORMED

BUSINESS NOTES
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Boiler Gage

Jerguson Gage & Valve Co., Burlington, Mass., announces a new high pressure boiler gage which uses the principle of light refraction to give a sharp black and white water level reading with strong contrast similar to that of reflex gages used with lower pressures.

The new Refragage employs a steel plate at both the front and back which is perforated with a line of small closely spaced holes up and down the 12 in. visible range. A flood light illuminator at the back of the gage passes light rays through an angular passage, and while the light passing through the water is refracted and lost to view, the light passing through the steam area shines brightly through the front line of holes above the water level.

The firm says the effect is similar to that of a reflex gage, giving a clearly marked separation between the black of the water level and the brightly lighted line above.

The gage has high visibility from a distance and from an angle up to 20 deg. It is also said to be ideal for TV or mirror transmission. It is heavily constructed for wsp to 3000 psi. The chamber is a solid bar of steel with a drilled hole and an angular machined passage, and both chamber and covers are carbon steel and rustproofed.

Resistance Comparator

A new instrument designed for accurately and rapidly checking the values of resistors for sorting or matching purposes, has just been announced by Technitrol Engineering Co., 1952 E. Allegheny Ave., Philadelphia 34.

The resistance comparator has an operating range of 50 ohms to 2 megohms and an accuracy of ±0.2 per cent or better. In operation the instrument compares unknown resistor values against a standard resistor, which can be any value within the instrument's resistance range.

The firm says types of measurements possible with the comparator include reading the per cent deviation from a standard value, checking unknowns against upper and lower limits, sorting resistors according to value, trimming series resistors to a standard value, or matching two resistors exactly.

Aluminum Coated Wire

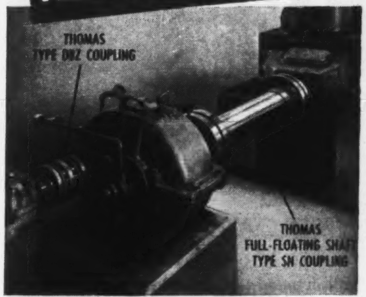
Aluminized steel core wires, strand guy wire, overhead ground wire, tie wire, messenger wire, telephone wire, chain link fabric and barbed wire are covered in Bulletin DH-537B, issued by Page Steel and Wire Div., American Chain & Cable Co.

It lists the properties and applications of these widely diversified hot-dip, aluminum coated wires and wire products said to combine the strength of steel and the corrosion resistance of aluminum in one end product.

PROTECT Your Machinery with

THOMAS

ALL METAL FLEXIBLE COUPLINGS



NO LUBRICATION

NO MAINTENANCE

NO WEARING PARTS

Future maintenance costs and shutdowns are eliminated when you install Thomas Flexible Couplings. These all-metal couplings are open for inspection while running.

They will protect your equipment and extend the life of your machines.

Properly installed and operated within rated conditions, Thomas Flexible Couplings should last a lifetime.

UNDER LOAD and MISALIGNMENT ONLY THOMAS FLEXIBLE COUPLINGS OFFER ALL THESE ADVANTAGES.

1. Freedom from Backlash Torsional Rigidity
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5. Original Balance for Life
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WARREN, PENNSYLVANIA, U.S.A.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Speed Reducer

An expanded line of shaft-mounted speed reducers announced by Dodge Mfg. Corp., Mishawaka, Ind., now includes a new 25:1 double reduction series in eight sizes. The line carries the trade name Torque-Arm.

The firm reports that it has improved the design of the double reduction reducers without changing their overall dimensions or horsepower ratings. Both 15:1 and 25:1 gear ratios are now available in housings of identical dimensions and at the same price. Output speeds range from 12 to 400 rpm.

Giant of the new series is Size TD11 described as the world's largest shaft-mounted speed reducer offered from stock. Its reduction ratio is 24.73:1 and it is rated at 154 hp at 75 rpm, which is the maximum recommended output speed for this size.

Seven other sizes with torque arms are available in either 15:1 or 25:1 ratios along with three flange mounted reducers. The firm is continuing its lines of 5:1 ratio single reduction Torque-Arm speed reducers and screw conveyor drives.

Elapsed Time Indicator

A subminiature elapsed timer weighing 3 oz and occupying a space of $1\frac{1}{16}$ in. od × $1\frac{15}{16}$ in., announced by Waltham Precision Instrument Co., has a total readout of 10,000 hr.

The firm says the unit is easily read to the closest hour. Features of the unit include jewel bearings, a fine precision gear train having 1.8 billion to 1 ratio, and a new, very low inertia motor.

The WT-1 was designed to be light and small enough to accompany black boxes of critical equipment anywhere, and to provide a continuous record of operational use and life (or failure) which is applicable for reliability and life testing, design and system analysis, utilization studies, operational maintenance, and procedures providing for replacement of equipment nearing the end of rated life, the company states.

Ductile Iron Valves

Conoflow Corp., 2100 Arch St., Philadelphia 3, is supplying Series LB control valves and Series IM handwheel valves with ductile iron bodies.

The valves are available in the straight-through design in sizes $\frac{3}{4}$ through 6 in., with 150–300# ASA raised face integral flanges. All meet ISA face-to-face dimensions. They are also available with screwed connections in sizes through 2 in. Pressure-temperature ratings are in accordance with Part UCN of the ASME Boiler Code, Sec. VIII.

Series LB and LM valves are still available in steel, bronze, and other castable alloys.

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says
AIR CARGO EQUIPMENT CO.
at Glendale, Calif.

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REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

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PREVENTS WEAR AND CORROSION
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SUPER-LUBRICATION
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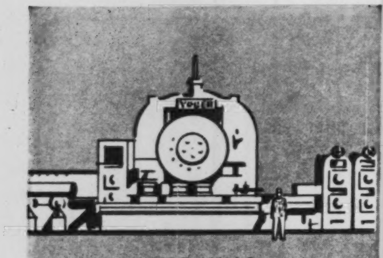

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Today's expanding markets and tightening economy demand closer production cost control. YODER'S complete line of ferrous or non-ferrous Pipe and Tube mills can help you meet production schedules economically... help you realize significant savings in the manufacture of tube and pipe.

YODER Pipe and Tube mills offer flexible production to meet fluctuating demand. They adapt easily to the most rigorous schedules. Everyday manufacture of constant high quality pipe and tube in diameter of 5/16" to 24". Speeds up to 350 fpm plus can be obtained with YODER mills.

YODER also makes a complete line of Slitting equipment and Cold Roll-Forming machinery. Send for your copy of the fully-descriptive book covering Tube Mill operation.

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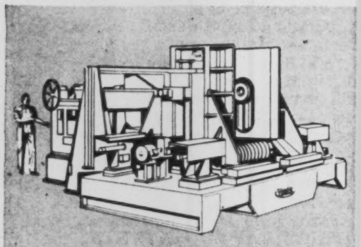
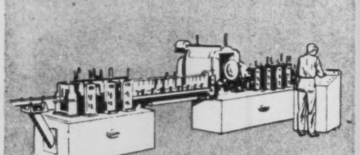


HEAVY DUTY UNCOILERS



TUBE MILLS

ENGINEERING YODER MANUFACTURING
PIPE AND TUBE MILLS
(ferrous or non-ferrous)

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BUSINESS NOTES
NEW EQUIPMENT
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Multiple Readout System

A 12-page catalog, No. 30B1000, describing multiple pressure readout systems which measure and record hundreds of different pressures simultaneously using a single high accuracy transducer, is available from Fischer & Porter Co.

Corrosive Service Valves

An improved line of Causul metal gate valves, designed especially for corrosive service, is announced by Lunkenheimer Co., Cincinnati.

The new valves, designated as Fig. 1910, are available in sizes 1/2 to 8 in., with screwed or flanged ends, King-Clip or bolted bonnet type, with either stainless steel or Monel trim, and are rated from 175 to 225 lb WOG.

The firm says the principal change in the new Fig. 1910 is the fullway design with full seat openings that maintain pressure and flow at the maximum for any specific size, 1/2 to 8 in.

The material from which valve bodies, bonnets, and glands are made, is an austenitic iron, containing about 20 per cent nickel, and substantial percentages of copper, chromium and molybdenum. The company says the valves successfully and economically handle sulphuric acid over a rather wide range of concentrations, alkalis, and many other corrosive fluids, in the manufacture of sugar, paper, rubber, caustics, fertilizers, coke and by-products, in oil refineries, water softening processes, and related installations.

Insulated Unions

A new line of Wedgeseal insulated unions for gas service applications announced by Eclipse Fuel Engineering Co. is now available in any combination of female or male threaded ends in 3/8, 3/4, 1, and 1 1/4-in. sizes.

The new insulated unions are designed to end electrolytic corrosion of mains and services by providing protection from induced or stray house current.

The union's construction features an insulator made of DuPont's Zytel 105. It is claimed to combine exceptionally high strength and improved insulating qualities in a material that is unaffected by natural, manufactured, or LP gas. In addition, it is form stable at 400 F and suitable for continuous operation at 275 F. The unions are recommended for working pressures up to 150 psig. Since the insulator extends over the flange and the washer face, there is no possibility of metal-to-metal contact, jumping or shorting, the firm reports.

The insulator is molded as a permanent part of the tailpiece of the union, doesn't require any assembly on the job and, thus, cannot be accidentally left off. The insulator is used in compression only and all threaded parts of the unions are metal.

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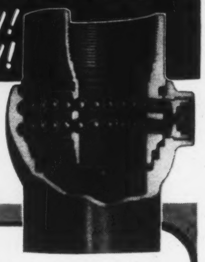

- BRONZE
- STEEL
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Full Unrestricted Flow • Effortless Movement • Greater Load Carrying Capacity • "O" Ring Sealed Contamination Free Operation • Perfect Alignment

FREE CATALOG F-8 provides engineering data, sizes, styles, recommendations and prices.

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TO

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CANCER
SOCIETY

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NEW EQUIPMENT
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Pressure Gages

A new series of pressure gages, known as the Master-test line, has been announced by Marsh Instrument Co., Skokie, Ill.

Made in all standard pressure ranges, and in compound and vacuum types, the new series of gages are individually dead-weight tested and guaranteed accurate within $^1/_4$ of 1 per cent plus or minus of the maximum dial reading over the entire range.

A new type of dial, called the Read-easy dial, has been developed in which the inner arc shows major markings and the outer arc the fine graduations as shown in the illustrations. This permits the gage to be read with the accuracy of a caliper rule, the firm reports.

Motor-Driven Timer

A 30-minute synchronous motor-driven timer is announced by Cutler-Hammer Inc.

The new unit features positive time selection and visual time indication. The company explains that since the dial is marked off in minutes with half-minute graduations, exact time is selected simply by rotating a bronze pointer to the timing cycle required. While in operation, the timer dial shows the full timing interval and the time remaining in the cycle. In case of power failure the timer automatically returns to its starting position for a full cycle when power returns.

The timer is designed for on-the-job interchangeability with either the one, three, or five-minute timing units. Each of the four will fit the same terminal and mounting block assembly, the firm states.

Tension Locking Fasteners

New flanged high tension locking fasteners, Tensilock locking screws and nuts, said to provide superior locking performance and eliminate need for washers in assembly of metal products, have been introduced by Russell, Burdsall & Ward Bolt & Nut Co.

The new one-piece fasteners lock with both ratchet-like teeth and high thread tension to provide a high ratio of off-torque to on-torque ratio.

The carburized teeth on flanges of the one-piece screw and nut are angled on the advancing side to allow low-friction tightening but are vertical on the back side to prevent loosening. In addition, a circular groove in the flange increases diaphragm action, flexing the flange as teeth imbed upon seating to help maintain residual tension in the fasteners. In contrast to a common screw or nut, where torque to release is less than application torque, the new fastener requires nearly 150 per cent of application torque to loosen. Re-usability is high, according to the manufacturer, on drilled or punched holes regardless of surface condition.

V-Belt Drives

A new line of standard V-belt drives incorporating interchangeable, quick detachable bushings has been announced by American Pulley Co., Philadelphia, Pa.

The new fixed pitch, standard sheave drives, called American Q-D-V, can be easily mounted on and removed from the shaft for easy maintenance.

The bushed sheaves are interchangeable with a wide range of equipment drives such as conveyor pulleys, fan drives, sprocket drives, couplings, and timing belts. The drives are designed to handle any power requirements from 1 to 1500-hp with speed ratios up to 8.55 to 1.00. The bushings for standard—A, B, C, & D—cross section belts are interchangeable with the QD bushings used on the larger sizes of the newly developed, compact 3-5-8 V-belt drives.

High-Temperature Resistor

International Resistance Co., 401 N. Broad St., Philadelphia 8, announces a small high-temperature wire wound resistor rated at 15 w.

Alloy coated leads for positive soldering are secured to a resistance element, uniformly and tightly wound on a glass fibre core, and sealed in a rectangular case with an exclusive matching cement. The firm says all materials are inorganic for protection against flame or decomposition at overload conditions. A highly automated production process insures consistantly high quality.

Refrigeration Machines

A new line of 2-stage Tonrac refrigeration machines for applications requiring 400 to 800-ton operating capacity is now available from American-Standard Industrial Div.

Designed specifically to provide chilled water for air conditioning of large buildings and factories, the new units are also adaptable to heat pump applications, the firm states.

The unit, designated Series 235, operates on Refrigerant 11. The company says an outstanding feature is its quiet, vibrationless operation as it maintains a constant chilled water temperature over the complete load range. Capacity is varied by adjustable inlet guide vanes; load control is completely automatic.

The new machines are powered by water-cooled hermetic motors, available for operation with 208 to 6600-v current. Compressor housings in the new machines are of cast iron construction; impellers are of cast aluminum alloy.

Operating at 3600 rpm, impellers are directly driven; they are supported on the overhung extended motor shaft.

From start to finish—fastening problem solutions

If you have a fastener problem in designing that new bridge, electronic computer or whatever your project, consider first this one *big* point. The fastener for your application may have already been produced. Think what a savings that would mean in both time and cost. Contact your Screw & Bolt Corporation representative—he can tell you which of our unlimited supply of standard fasteners can best solve your problem. It will pay off for you.

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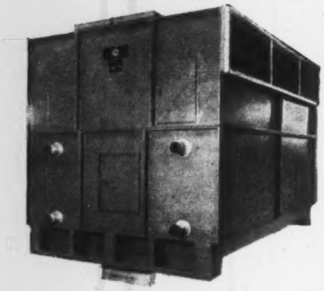
America's Most Complete Line of Industrial Fasteners



This Self-Contained Fluid Cooling System ... gives most accurate temperature control

Applied in cooling industrial machines or processes to temperatures approaching the ambient wet-bulb, the NIAGARA *Aero* HEAT EXCHANGER is independent of any more than a nominal water supply or disposal. The coolant system is a closed one, free from dirt and maintenance troubles.

Heat is removed from your process *at the rate of input,* giving you precisely the temperature you require and assuring the quality of your product. Heat may be added to prevent freezing in winter or for better control in a warm-up period. Liquids or gases are cooled with equal effectiveness.

Heat is rejected outdoors. Only the little water evaporated on the cooling coils in the air stream, or discharged to prevent hardness build-up, is consumed.

Niagara sectional construction saves you much installation and upkeep expense, gives full access to all interior parts and piping. Your equipment always gives you full capacity and "new plant" efficiency.

Write for Niagara Bulletin No. 132 for complete information

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Mechanical Engineers

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THE ENGINEERING INDEX
29 W. 39th Street, New York 18, N. Y.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Pressure Switch

Haydon Switch, Inc., announces its 1580 series pressure switch which weighs 4 oz max, and measures 3 in. long by $1\frac{1}{2}$ in. at its widest diameter.

Ambient temperature range is −65 to 300 F, and special versions can be provided for operation at temperatures up to 600 F. The switch is factory-set to actuate at any desired pressure level within the range of 0.5 to 4000 psi.

All moving parts are contained in an aluminum housing, environmentally-sealed by O-rings at each end. The firm says the entire assembly is resistant to corrosive operating media, such as water-alcohol solutions, nitric acid, and hydrogen peroxide.

Gas Regulators

Two new high pressure gas-o-dome regulators, the GD100 and GD200 series, designed primarily for high flow regulation of non-corrosive gases and liquids used in missiles and industrial applications, are announced by Victor Equipment Co.

Both regulator series operate at maximum inlet and outlet pressures up to 6000 psi, have a proof pressure of 12,000 psi and an operating temperature range of −67 to +250 F. Dome pressures for gases or liquids are regulated by loader valves or by regulators.

The GD100 series is available with valve and orifice sizes from $^3/_8$ to $^3/_4$ in, with AN tubing or piper connections. Outlet pressures rise 1 to 4.5 psi per 100 psi of inlet decay, depending on orifice size. Maximum flow is 20,000 scfm. Constructed with forged bronze body, stainless steel valve and Kel-F seats.

The GD200 series has a $1\frac{1}{2}$ in. orifice and is compensated to provide constant outlet pressure as inlet pressure decays. Connections are either 1500-lb ASA flanges for 3600 psi applications at ambient temperatures, or 2500-lb ASA flanges for 6000 psi applications. Maximum flow is 50,000 scfm. Construction is stainless steel with Kel-F seats.

Strain Gages

Three new, high accuracy MetalFilm strain gages are announced by Tatnall Measuring Systems Co., Subsidiary of Budd Co.

Listed among applications of the new units are high speed aircraft, missiles, and jet engines. Two of the gages are fully temperature-compensated for four alloys.

The smallest gage measures $^1/_{32}$ in. wide, $^5/_{32}$ in. long and $^1/_{1000}$ in. thick; the largest is $^1/_2$ in. square and $^1/_{1000}$ in. thick. Weight of the gages ranges from 1.1 mg to 9.3 mg.

The units are: rosette gage to determine magnitude and directions of principal strains; miniature gage for use in areas of very steep strain gradient; high fatigue life gages for structures undergoing severe dynamic strains.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Shut-off Valves

A new series of screw stem shut-off valves, designed to prevent both leakage to atmosphere, and clogging of activating threads by viscous fluids, has been developed by Anderson Brass Co.

According to the manufacturer, the new 30V-50V series feature a single Buna N O-ring which by its designed position eliminates leakage problems and maintenance costs, and provides improved performance over a longer period of time.

The new unit is available in standard models for use with fuel oil, gasoline, kerosene, air, water, mild alkalies, acids, alcohols, and coolants up to 500 psi at −40 to +250 F. It is available in 1/8 and 1/4 in. IPT sizes. Large wheel handle is standard, and options include instrument type knurled wheel handles, orifice locking devices and panel mountings.

BUSINESS NOTES

Metal Research Center

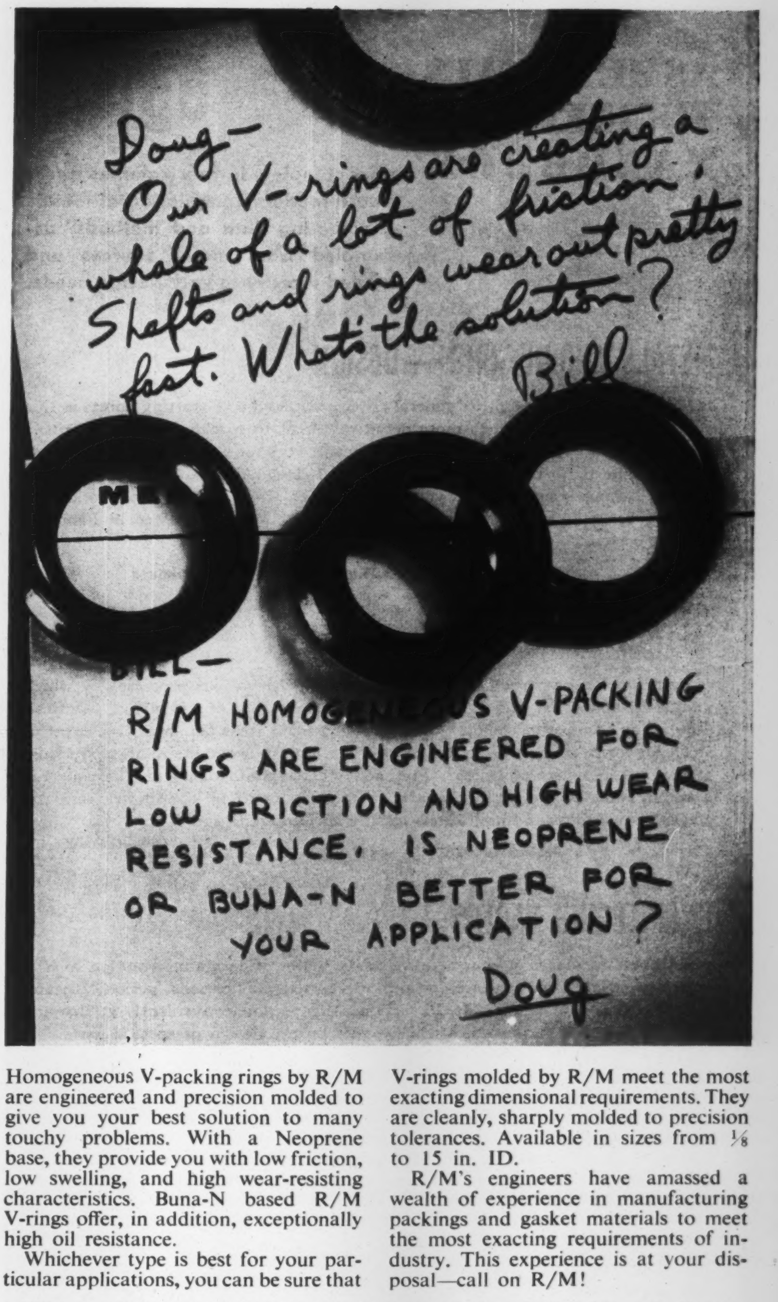
A metallurgical research center to speed development of high-temperature metals for jet engines, rockets and missiles, atomic power generators, and other hardware of advanced design, will be constructed at the du Pont Co. Baltimore plant.

The installation will contain equipment to forge, extrude, roll, draw, and heat treat such refractory metals as niobium, tantalum, titanium, zirconium, tungsten, and chromium. It will be capable of producing mill products—ingots, tubes, rod, sheet, strip, and foil for sales development programs. The facility will be housed at the du Pont plant in the Curtis Bay section of Baltimore where, since 1931, the company has manufactured titanium dioxide white pigment. The installation is scheduled to be completed by the fall of 1960.

New Oxygen Furnaces

Construction on the two largest basic oxygen furnaces in the world and one of the largest blast furnaces in the United States will be started at the Cleveland Works of Jones & Laughlin Steel Corp. this summer.

The firm said the program will cost approximately $50 million, and will equip the Cleveland plant as one of the most modern in the country. J&L purchased the Cleveland Works—formerly the Otis Steel Co.—in 1942 at a cost of $39 million. Since then, it has expended more than $165 million in equipping this unit as one producer of hot and cold rolled sheets, principally for the automotive and appliance industries.


Doug—
Our V-rings are creating a whale of a lot of friction. Shafts and rings wear out pretty fast. What's the solution?
Bill
BILL—
R/M HOMOGENEOUS V-PACKING RINGS ARE ENGINEERED FOR LOW FRICTION AND HIGH WEAR RESISTANCE. IS NEOPRENE OR BUNA-N BETTER FOR YOUR APPLICATION?
Doug

Homogeneous V-packing rings by R/M are engineered and precision molded to give you your best solution to many touchy problems. With a Neoprene base, they provide you with low friction, low swelling, and high wear-resisting characteristics. Buna-N based R/M V-rings offer, in addition, exceptionally high oil resistance.

Whichever type is best for your particular applications, you can be sure that V-rings molded by R/M meet the most exacting dimensional requirements. They are cleanly, sharply molded to precision tolerances. Available in sizes from 1/8 to 15 in. ID.

R/M's engineers have amassed a wealth of experience in manufacturing packings and gasket materials to meet the most exacting requirements of industry. This experience is at your disposal—call on R/M!

R/M's complete line of mechanical packings includes Vee-Flex* and Vee-Square* Packings, Homogeneous V-Rings, and Fabric Piston Cups. Write for complete information.

R/M
PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

ASME METALS ENGINEERING HANDBOOK

now complete in four volumes offers you a modern compilation of metals engineering data and methods, assembled from many sources and related directly to your design needs.

METALS ENGINEERING—DESIGN

Metals properties and other general criteria serve only as starting points in this volume. It gives you much more detail pertinent to special design problems—shows you how to test to see how a material will work for a specific purpose. . .how to determine performance of parts in your design. . .how to strengthen metal parts according to the uses that you need them for. . .how to design for production to keep costs down. Facts you get represent current practices in handling fatigue, corrosion, non-destructive testing, elasticity, etc.

Published 1953 405 pages 560 illustrations $10.00

METALS ENGINEERING—PROCESSES

In this volume you will find detailed data on the various processes by which metals are converted into finished products. Composed of a wealth of practical, day-to-day engineering helps, the book covers such areas as: heat treatment of steel, all forms of casting, hot and cold working, powder metallurgy, welding, machining, and electroforming. For each of the manufacturing methods there is a compilation of the basic physical characteristics to be considered, and the general advantages and limitations usually encountered.

Published 1958 448 pages 512 illustrations $13.50

ENGINEERING TABLES

This volume places in your hands a ready source of design information to save you from losing time in searching out specialized publications, periodicals, and miscellaneous data sheets. In 15 sections, this volume conveniently groups and arranges together those tables which apply to the design of specific parts. It covers such subjects as bar stock and shafting; bearings; spur, helical, herringbone, bevel, and worm gears; cylindrical fits; keys and keyseating; bolts; springs; aircraft and mechanical tubing; electrical motors, and gaskets.

Published 1956 692 pages 560 tables $12.00

METALS PROPERTIES

The specific information a designer must have about the properties of the metals with which he must work is assembled for your convenience in this book. For more than 500 metals it tabulates working data on the metallurgical, physical, fabrication, and mechanical properties of metals—such typical data as chemical composition, industrial uses, draw temperatures, tensile strength, yield point, Rockwell "C" core hardness, hot working temperature, coefficient of thermal expansion, end-quench hardenability, etc.

Published 1954 445 pages 531 illustrations $11.00

20% discount to ASME members

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 W. 39th St. New York 18, N. Y.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Research Division Formed

A new research and development division for proprietary products has been organized by American Machine & Foundry Co., 261 Madison Ave., New York 16.

The new division will bring together in one corporate unit AMF's chemical research and development laboratory at Springdale, Conn.; the central research laboratory and the engineering services laboratory, both at Stamford, Conn.; the advanced development laboratory at Buffalo; and the research and development and the commercial development divisions at AMF headquarters in New York.

LATEST CATALOGS

Weldments, Condensers

New, illustrated brochure describing C. H. Wheeler's manufacturing plants and equipment is available to interested executives.

Representative machine tools, interiors of plants and engineering and design operations are illustrated.

The firm's power plant division, its Economy Pump Div. and Marine and Nuclear Components Div. are covered. Also Wheelerweld Div. in Ambler, Pa., where weldments are fabricated to custom specifications. Major emphasis is on the company's ability to fabricate steam condensers, steam jet vacuum equipment, centrifugal, axial and mixed flow pumps, marine equipment, nuclear components and similar large machinery.

Amplifiers, Power Supply

Five two-page bulletins in a folder describe the complete line of miniature, lightweight amplifiers, and power supply for magnetic tape recording available from the Data Tape Div., Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Photographs and drawings illustrate operation, specifications, and applications of Type 3-135 power supply, Type 1-135 analog record amplifier for reference or multiplexed RDB-FM/FM data signals to drive the record heads of airborne or ground station recorders; Type 1-135MA Analog record amplifier with microphone preamplifier, Type 1-136 PDM record amplifier; and Type 1-151 FM record amplifier which converts analog data signals into a frequency-modulated carrier prior to recording on magnetic tape.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
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Polyurethane Rubber

An eight-page brochure describing in detail Goodyear Tire & Rubber Co., Neothane castable polyurethane rubber, has been published by the Akron, Ohio firm.

Neothane is described as a new molecular composition for practical applications in areas that heretofore were beyond the ability of rubber products. In the pure gum form, it is harder than most conventional rubber compounds and has from two to four times the strength. The new product performs better than metals in applications requiring the combined properties of toughness, resilience and abrasion resistance, the company states.

Railroad Fasteners

A four-page bulletin, Form 8-471, describing fasteners for railroad construction and maintenance is available from Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7.

The bulletin describes and illustrates the CL, OS, DR, 9SP, and PT fasteners of particular interest to railroad design and maintenance engineers. General specifications are given and typical applications are described and illustrated.

Delay Lines, Test Equipment

A new technical brochure published by Technitrol Engineering Co., 1952 E. Allegheny Ave., Philadelphia 34, illustrates and describes its standard line of distributed constant delay lines and pulse test equipment.

The brochure lists all electrical specifications on the 25E, 25F, 25G, and 25J series delay lines such as impedance, delay, rise time, attenuation, and test voltage, and includes environmental characteristics. Also illustrated with physical dimensions are the various case styles available which include metal cans, epoxy sticks, and dip coated units. Prices are given for all delay lines carried as stock items in quantities from 1 to 99.

Instruments, Recorders

An eight-page illustrated condensed catalog has been released by Hays Corp., Michigan City, Ind.

The condensed version is divided into seven sections for convenience of the user. Sections 2 through 6 list instruments according to the five major process variables—pressure, flow, temperature, level, and gas analysis. Section 7 lists receivers including the new Universal electronic recorder. Section 1 of the bulletin describes all-electric combustion control systems, which are coordinated with boiler room instrumentation to provide fully automatic combustion control.

Fatigue Fighters at 1000° F.!

These Flexible Connectors Conquer:

- Shock
- Vibration
- Pressure
- Abrasion
- Corrosion
- Temperature

Bring on your toughest airborne applications . . . and there's a Fulton Sylphon bellows flexible connector to do the job! Single or multiple ply Sylphon® Bellows provide dependable connector performance for high-speed aircraft, missile and rocket applications . . . connecting shafts, misaligned pipes, shifting terminals, etc. Custom-engineered of stainless steel, inconel or inconel-X, where high temperatures are a problem; brass or bronze; or beryllium copper for conditions where exceptional stability and long life are of critical importance. They can be made in a wide range of sizes and styles, including braid-covered.

Write for Engineering Bulletin RK-1400

Mr. Controls

Robertshaw-Fulton®

CONTROLS COMPANY

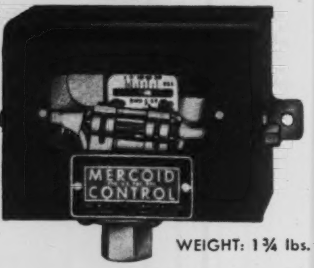
FULTON SYLPHON DIVISION • Knoxville 1, Tenn.

NEW

Small, Lightweight

MERCOID PRESSURE CONTROL

AP-153

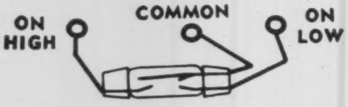


WEIGHT: 1¾ lbs.

FOR MEDIUMS NOT INJURIOUS TO STEEL OR SILVER SOLDER

CIRCUIT

SP-DT HERMETICALLY SEALED MERCURY SWITCH (4A. 115V., 2A. 230V.)



Provides any of following operations:

1. *Single Pole—Cut-in high (close on rise)*
2. *Single Pole—Cut-in low (open on rise)*
3. *Single Pole—Double Throw*

OPERATING RANGE

ADJUSTABLE OPERATING RANGE	SWITCH DIFFERENTIAL PSIG. With Pointer Set At LOW	HIGH
1 to 20 psig.	0.3	0.5

CONSTRUCTION

ADJUSTMENT: External
PRESSURE ELEMENT: Fairprene diaphragm
PRESSURE CONNECTION: ¼" I.P.S.
MOUNTING: Has two mounting ears (one on each side of control) or control may be pipe mounted by means of the ¼" I.P.S. bottom connection.
INTERNAL WIRING CONNECTIONS: 3 post terminal block.
CASE: NEMA 1—Heavy gauge steel, cadmium plated. Steel cover (with glass front) finished in charcoal-gray.

WRITE FOR BULLETIN 02

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

General Purpose Presses

Bulletin 370-E describing hydraulic general purpose presses which range in capacities from 30 to 200 tons, has been issued by Farrel-Birmingham Co., Watson-Stillman Press Div., 565 Blossom Rd., Rochester 10, N. Y.

Hydraulically operated, the presses are designed for laboratory and experimental work as well as application in the plastic, metalworking, and general industrial fields.

Crane-Excavator

A 24-page catalog describing its 40-ton crawler crane-excavator has been released by the American Hoist & Derrick Co., St. Paul, Minn.

The catalog describes and illustrates how the machine, designed for tremendous working capacities can also have small crane mobility. It converts to a crane-dragline-clamshell-shovel-backhoe-pile driver or for special grapple work.

Water Control System

A side-stream boiler water control system that is claimed to keep continuously and automatically boiler water crystal clear by eliminating sludge and suspended solids has been introduced by Sparkler-Filtrion Corp.

The new system is available in standardized models for all types of steam boilers up to 1000 hp and customized units for boilers up to 6000 hp.

The firm says reports on actual comparative conditions checks on two boilers operating side-by-side, one on a normal treatment program, show the new systems can save up to 20 per cent of fuel consumption, up to 75 per cent on treatment chemicals, up to 75 per cent on blowdown heat and water losses, and up to 100 per cent of contaminated condensate losses.

Control Valves

DeZurik Corp., Sartell, Minn., has announced the release of a new bulletin describing its complete line of control valves.

Identified as Bulletin 150, the new publication lists valve bodies and actuators and the accessory line available for the valves. Valve sizing data is also included in the bulletin. A description of the firm's eccentric principle is diagrammed, and primary advantages of the valves are listed.

Business Machines

Publication of a 12-page manual entitled "Visible Control for Machine Systems" has been announced by Remington Rand Div., Sperry Rand Corp., 315 Fourth Ave., New York 10.

The manual explains how visible record-keeping systems and housing equipment facilitate sound management decisions, and at the same time get the work done faster by expenditing machine operations. It covers equipment for inventory and sales control and for accounts receivable.

Shape Cutting Machine

Intricate metal parts can be reproduced from simple pencil sketches on ordinary paper with a new, fully automated flame-cutting machine described in an eight-page booklet available from Linde Co., Div. of Union Carbide Corp., 420 Lexington Ave., New York 17.

The unit, called Oxweld CM-60, is claimed to be the world's first unlimited capacity shape-cutting machine that can automatically reproduce metal parts from exact size drawings. Oxy-acetylene cutting torches on the unit faithfully follow electronic impulses from a photocell tracer. Intricate parts are produced by simply feeding exact size drawings of the part into the tracing system.

Definitions of Occupational Specialties in Engineering

This book contains comprehensive data related to all activities and specializations in engineering including specific knowledge and duties, responsibilities and related techniques necessary for successful performance in each field.

The ten activity fields defined are research, design, development, testing, procurement, production, construction, operation, administration, and teaching.

Major engineering fields of specialization defined include aeronautical, automotive, ceramic, chemical, civil, electric and electronics, guided missiles management, marine, materials, mechanical, metallurgical, mining, naval, nuclear reactor, ordnance and armament, petroleum and fuels and power plant engineering. Other engineering fields defined are: packaging, photogrammetry, agriculture, geology, and geophysics.

Pub. 1952 Price: $2.50, 20% less to ASME members.

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KEEP INFORMED

BUSINESS NOTES
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Symbol Reference Chart

JIC hydraulic and pneumatic symbol reference chart is offered free by Republic Mfg. Co., 15655 Brookpark Rd., Cleveland 35.

It is designed for ready reference to standard symbols, and cross referenced for the firm's valves.

Filter Media Selection

Purolator Products, Inc., Rahway, N. J., has issued a chart on the selection of proper engineering materials and filter media for given types of corrosive conditions.

Prepared in booklet form, the chart lists filter media for varying concentrations of more than 125 corrosive agents. The new booklet, designed PUR-66D, lists corrosive agents varying from acetic acid to zinc chloride; concentration percentages; temperatures; and filter media of metallic, plastic, or other type design.

Chain Drives, Elevators

Chain Belt Co. has issued two new handbooks outlining installation, operation, and maintenance procedures for chain drives (Bulletin 59126), and chain conveyors and elevators (Bulletin 59127).

Both bulletins are pocket-size editions containing information on how to install, operate, maintain and extend the life of drives and conveyors.

Worm Gear Selection

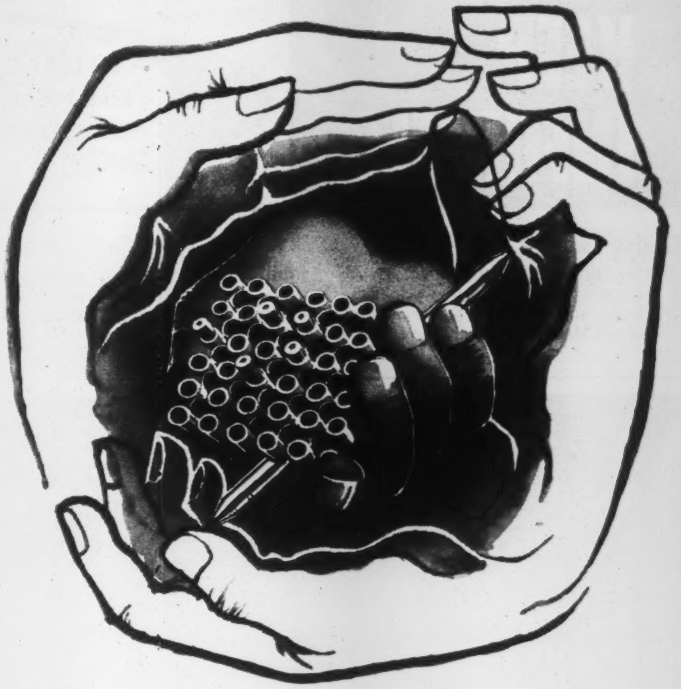
A catalog that provides basic data needed for accurate selection of worm gear sets has been published by De Laval Steam Turbine Co.

The new publication covers Delroyd worm gearing and is illustrated with explanatory drawings. It contains basic information on worm gearing, and provides design data and information on the special features of worm gearing, how to select it, and how to calculate bearing loads.

Aircraft Controls

A bulletin available from Airborne Accessories Corp., Hillside 5, N.J., describes the company's new packaged modular control systems which are built or assembled entirely from standard units, assemblies and sub-assemblies. These matched systems are suitable for use in the aircraft, missile, electronic control, and related fields.

The four-page bulletin, PS-5A, contains charts and photographs of units in the system which include transducers, contactorless control packages consisting of standardized control boxes into which are plugged transistorized or magnetic preamplifier and power amplifier subsystems and modular linear or rotary actuators built from standardized interchangeable parts.



TO THE **M. E.'s M. E.**

To generate, to control, to convert atomic fission to usable power is the result of many skills, many talents . . .

The application of advanced engineering concepts to the problems of reactor design and development, to control rod fabrication, to the thermodynamic environment within the reactor and the steam generating system requires the highest kind of mechanical engineering knowledge—requires men of unlimited ability, of unlimited imagination.

The Atomic Power Department of Westinghouse is now engaged in a vast expansion program where Mechanical Engineers with unique ability can apply their speciality to the design and development of tomorrow's nuclear power plants.

SENIOR ENGINEER with a BSME or MSME degree to do hydraulic, thermodynamic, and strength calculations: to take responsibility for the design and procurement of components for a primary nuclear system. A sound background in thermodynamics is required with some training in metallurgy. Five to ten years experience is a prerequisite.

ASSOCIATE ENGINEER with one to three years experience and a BSME or MSME degree. Will assist in the mechanical design and analysis of reactor core components such as fuel assemblies, control rods and core support structures.

Send resume to Mr. C. S. Southard, Westinghouse Atomic Power Department, P.O. Box 355, Dept. W-37, Pittsburgh 30, Pa.

Westinghouse

FIRST IN ATOMIC POWER

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NEW EQUIPMENT
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Machine Tools

A newly revised 48-page catalog, describing the firm's line of light-heavyweight machine tools and accessories, has been issued by Rockwell Mfg. Co., Walker-Turner Power Tool Div.

Some of the industrial tools described are drill presses, grinders, cut-off machines, band saws, and belt and disk surfacers. Specifications, catalog listings, and descriptions of accessories for all tools are included. Photos and drawings supplement the text.

Variable-Speed Drives

Sterling Electric Motors, Inc., announces the availability of a Speed-Trol variable-speed drive bulletin, No. 195.

The bulletin contains photographs of basic types of variable-speed drives and a variety of modifications, including a separate motor drive horizontal assembly, and a newly-designed shaft-mounted right-angle variable-speed drive.

Suggested variable-speed applications are included, along with information regarding horsepower, duty, speed variation, mounting styles, enclosures, and electrical characteristics.

Melting Techniques

Firth Sterling, 3119 Forbes Ave., Pittsburgh 30, has released an eight-page brochure on its new Hopkins process (Stercon H) melting process.

The brochure describes the five melting techniques currently being used by the firm. Relative merits of material produced by the process are illustrated with photographs of macro-etch disks. Included are tables showing physical properties at room and elevated temperatures, illustrating the uniformity of Stercon H A-286, Discaloy, SAE 4340, and 16-25-6.

Atomizing Nozzles

Spraying Systems Co. announces its Data Sheet 8085 covering its new 0011 series flat atomizing nozzles for spraying operations requiring a flat atomized spray at exactly controlled and extremely low volume.

The nozzles are believed to be the smallest capacity hydraulically operated flat spray atomizing nozzles ever designed. At 40 lb pressure, rated capacity of the nozzles is $^2/_3$ gal per hr. Three different spray angles available. The nozzles are precision made with orifice dimensions equivalent to a .009" diam.

A high degree of uniform atomization is obtained by hydraulic pressure alone, no pneumatic connection is required.

PRECISION
BORED and HONED PARTS
FOR THE NUCLEAR INDUSTRY

As specialists in deep boring and super honing, we are geared to produce hollow parts for the Nuclear field. For over 40 years we have confined our operations exclusively to the manufacture of precision hollow parts. We have worked in practically all the known metals and alloys and have the skills and equipment to meet the most exacting specifications.

PRECISION BORING
AMERICAN HOLLOW BORING CO

May we send you a copy of a 20 page brochure describing our services?

AMERICAN HOLLOW BORING CO.

You can depend on American as a reliable source for precision bored and honed parts for your most exacting applications.

1058 West 20th Street • ERIE, PENNA.

FIGHT HEART DISEASE
GIVE HEART FUND

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Turret Drilling Machine

Brown & Sharpe Turret Drilling Div., Inc., has issued Catalog No. 1T which contains features of design and construction of the company's new turret drilling machines and work-positioning tables.

This catalog explains the firm's drilling technique which utilizes a machine on which six spindles work on a single axis so that tools for drilling, tapping, boring or reaming can be indexed in any sequence and locked into alignment with the main drive spindle. Work-positioning without the use of guide bushings or box jigs by means of the work-positioning tables is also described.

Portable Batching Plant

A new electrically controlled high speed portable batching plant for highway and airport paving is featured in a bulletin available from Blaw-Knox Co.

It describes and illustrates operating features of the plant's dual automatic cement batcher with 2-pen recorder, 600-barrel cement bin, an automatic aggregate batcher with 4-pen recorder, and 4-compartment aggregate bin. Illustrations of the rapid erection procedure as well as the equipment loaded for shipment are also contained in the publication.

Molded Cups

A bulletin describing the latest types of molded cups for pump pistons, hydraulic service, and for pneumatic equipment has been published by Garlock Packing Co.

The new booklet, which updates previous literature on this subject, is designated Bulletin AD-145, and it details the construction, recommended service and available sizes of rubber and synthetic rubber, leather, reinforced synthetic rubber, metal bonded and metal reinforced and homogeneous cups. The bulletin also contains tables illustrating the most popular cups for recommended services on a wide variety of general applications.

Cathode-Ray Tubes

A condensed catalog showing the principal specifications of 55 JEDEC registered cathode-ray tubes for original equipment use has been issued by Electronic Tube Div., Allen B. Du Mont Laboratories, Inc.

The catalog gives physical characteristics, maximum electrical ratings, and typical operating conditions of the company's latest designs in standard cathode-ray tubes. Tubes are indexed for selection of correct sockets and connectors. Twenty-three other registered tubes are listed for replacement purposes

Electric Doors, Controls

A 16-page catalog presents the Barber-Colman line of residential, commercial, and industrial overhead doors and electric door controls.

The book gives information on new Weather-King flush sections, combining high-insulation-value sandwich construction with guaranteed weatherproof facing. Panel doors, electric operators, radio controls and special controls are described and illustrated.

Solutions to special installation problems are given with detail drawings.

DRY! SCREEN! CONVEY!

ONE Carrier Conveyor Does It All!

A well-known chemical processor needed a unit that would *dry* and *convey* 5/16″ carbonaceous particles at a rate of 2 TPH (on a limited floor area).

This efficient Carrier Natural-Frequency Dryerveyor (60′ long, 12″ wide) *filled the bill!* It reduced conveying, drying and maintenance costs, and Carrier pre-assembly made installation easy.

This custom engineered Carrier Dryerveyor has an easy-to-adjust dual drive that permits two different conveying speeds — one for drying (2 TPH) and one for standard conveying (15 TPH).

The moist particles are quickly dried by the 350°F. air which passes through them as they vibrate along the screen deck. The drying section is designed to expand or contract without stressing the structural parts. *Particle moisture is reduced from 14% to .5%* and fines are removed before the material enters the 30′ conveying section.

For more information, write: Carrier Conveyor Corporation, 224 North Jackson St., Louisville, Ky.

CARRIER
NATURAL-FREQUENCY®
VIBRATING EQUIPMENT
Engineering Specialists in Vibrating Equipment

CONVEY ● FEED
DEWATER ● SCREEN
COOL ● AGGLOMERATE
DRY ● SCALP ● COAT
DISTRIBUTE ● ELEVATE
● FLATTEN BAGS

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NEW EQUIPMENT
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Spring Clutches

Marquette Div., Curtiss-Wright Corp., Cleveland 10, announces publication of a catalog describing five standard lines of spring clutches in bore sizes from 1/8 to 1 in. and torque capacity up to 1250 lb-in.

The spring clutches are specifically designed for use in machinery, equipment, and instrument applications utilizing drive up to 5 hp. The firm says the catalog marks the first time such a wide range of spring clutches has been available as a standard off-the-shelf item in stock for immediate delivery.

Phenolic Resin Plastic

Equipment Sales Div., Raybestos-Manhattan Corp., Bridgeport, Conn., has available for distribution a 12-page bulletin on the physical properties and application of Pyrotex—the firm's asbestos-reinforced, thermosetting phenolic resin plastic.

The material, featured by exceptional dimensional stability, has a high modulus of elasticity and strength, and is both chemical and water resistant. In addition, it has a wide range of frictional characteristics, is nonabrasive and low in cost. The material, which is laminated and molded, can be machined into precision parts of high performance. It is often combined with other resins—silicone, epoxy, and polyester for some applications.

O-Ring Seals

A booklet outlining the physical and mechanical considerations of O-ring selection is being offered by Auburn Manufacturing Company, Middletown, Conn.

The book contains engineering data and reference tables simplifying selection, installation, lubrication, and maintenance of O-ring seals. It also covers materials, machining, and finishes which have consistently proved compatible with superior O-ring sealing.

Vacuum Pumps

Four standard mechanical booster vacuum pumps with maximum pumping speeds of 1100, 1200, 3200, and 5700 cfm, are described in a four-page folder, Bulletin 515, published by the Vacuum Equipment Div., F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20.

Performance curves and complete specifications are given, as well as a description of the outstanding design features. The pumps are compact two-stage high-speed pumping units, consisting of a high-capacity Roots-type dry blower as the first stage, backed by a gas-ballasted rotary piston-type mechanical vacuum pump capable of very fast roughing as the second stage.

Casting Aluminum

Casting aluminum is the subject of a new technical handbook available from Reynolds Metals Co., Richmond 18, Va.

The 32-page, reference includes information on various casting processes suitable for aluminum. Featured are recommendations on alloy selection, plus an extended discussion of various alloying elements and their effects. Design of aluminum castings is explained, while a special section is devoted to the handling of molten aluminum. Information on trimming and cleaning of castings completes the text.

oh say can you see?
...WIDELY USED FOR TRACKING AND RADAR BORESIGHTING...

"FAR-SIGHTED" MIRROTEL LENSES CAN

Wollensak Mirrotel Lenses (20", 40" and 80") extend the capabilities of high speed motion picture photography in tracking missiles and in radar boresight applications. They deliver images of excellent resolution and contrast.

ADVANTAGES • Because of mirror optics (the light path is "folded" three times within the system) the lenses are short and lightweight . . . are free from chromatic aberration, coma, astigmatism, distortion . . . are most stable under extreme environmental conditions. Invar rod mounting permits high boresighting accuracy.

CAMERAS • Mirrotel lenses are extensively used with a wide variety of cameras, such as FASTAX, FASTAIR, Flight Research IV-C, Automax, Mitchell (16mm, 35mm), Cameraflex, Eyemo and TV cameras.

SPECIAL FEATURES • Mirrotel Lenses can be supplied with reticle printers, fiducial markers, continuous focusing, counters, reflex finders, radiation shields, custom mounting bases for lens and camera (illustrated), neutral density and color filters.

If you need extra long focus lenses of unusual characteristics, **WRITE** Dept. FXL for Mirrotel catalog M-1 and prices. Inquiries invited.

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WOLLENSAK
OPTICAL COMPANY • ROCHESTER 21, N. Y.

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Injection Molding Machine

A six-page bulletin describing new 16-oz horizontal injection molding machines available in two models, has been issued by Farrel-Birmingham Co., Watson-Stillman Press Div., 565 Blossom Rd., Rochester 10, N. Y.

Similar in other respects, the two designs differ in their injection speeds, thus permitting the choice of a model with an injection rate that is suited to the type of material to be molded. The bulletin describes the design features of the machine and lists the general specifications and die space dimensions.

Propeller, Mixed Pumps

A bulletin released by Layne & Bowler, Inc., Memphis 8, Tenn. covers propeller and mixed flow pumps.

Information includes cut away drawings, installation sketches and measurements, delivery and performance tables, plus information on uses and applications.

Belt Conveyors

A handbook on the use and selection of standardized Pre-Bilt sectional belt conveyors has been released by Link-Belt Co., Prudential Plaza, Chicago 1.

The conveyors, pre-engineered and shop-assembled from matched components, are said to be adaptable to a large proportion of belt conveyor applications and operating conditions. The 40-page handbook, Book 2779, lists 22 components and accessories detailing engineering and selection data. Illustrations show installation applications in a variety of industries and typical layouts.

Hydraulic Valves

A manual illustrating and describing the operation and application of pressure controlled hydraulic valves has been published by Rivett, Inc., Boston, Mass.

The new 20-page book contains information on the valve's uses for relief, sequence, reducing, unloading, and counterbalance. The 3000 psi, pressure controlled valve is designed for modern hydraulic circuit providing automation of machine operation.

Power Factor Capacitors

Construction features of substation and pole-mounted power factor capacitors are described in a bulletin released by Allis-Chalmers, Milwaukee 1.

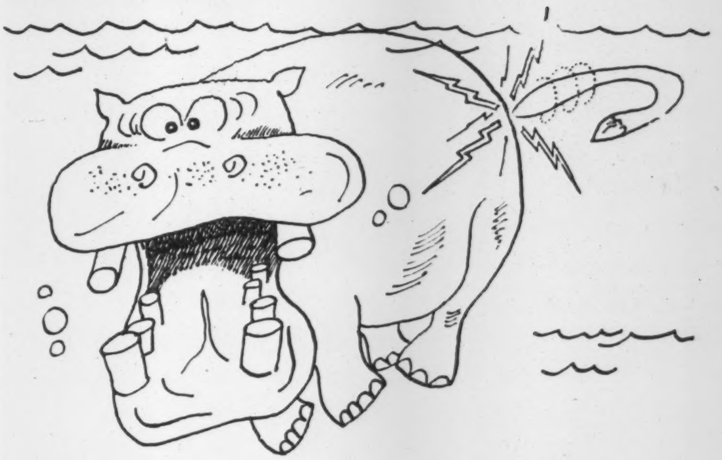
Available in ratings of 25 and 50 kvar in 2400 through 7960 v, the capacitors meet all national standards for size, voltage, range, and dimension. They are factory assembled for single-row or multi-row configuration or for stacking racks to users' requirements.

Welding Technique

A new brochure describing its welded assembly technique for high density packaging of electronic components is available from Industrial Tube Div., Raytheon Co., 55 Chapel St., Newton 58, Mass.

The packaged assemblies, miniaturized by precision welding of components into modular sticks, are encapsulated with plug-in terminals. This method is designed to eliminate conventional leads and wiring and enables more than 100 components to be packed into each cubic inch.

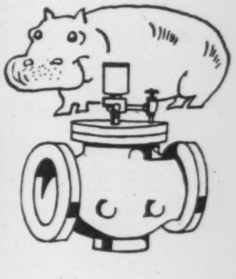
OPENS ON ELECTRICAL IMPULSE



G-A *Cushioned* Solenoid Operated Valve

Where remote control valve operation is desired, specify and use the G-A Cushioned Solenoid Operated Valve that automatically opens or closes on any type of electrical impulse. The operating sequence—whether on open or closed circuit—can be made to suit your requirements. Sizes 2" to 36".

Bulletin W-7A has the complete story.



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Designers and Manufacturers of VALVES FOR AUTOMATION

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PARALLEL SHAFT
HELICAL
GEAR DRIVES

1. Heavy duty, reinforced design housing for permanent alignment, rigid shaft support.
2. One mesh per reduction—fewer moving parts.
3. Broad faced helical gearing—high quality, accurately hobbed for greater strength, durability. Uniform tooth deflection under load . . . no uneven wear.
4. Shafts firmly held in place. Positive gear location assures full tooth engagement across entire face.
5. Smooth, overlapping mesh, close backlash tolerances, no oil trap, provide quiet operation, less heat generation.
6. Heavy duty, anti-friction bearings. Conservatively rated for wide range of operation.

Capacities to 1550 H.P.

- ★ **Single, Double, Triple Reductions**
- ★ **Standard Ratios from 2.08 to 1 up to 360 to 1**
- ★ **9 Shaft Arrangements**
- ★ **Available With Fabricated Steel Housing**

There's more capacity, greater stamina and longer service life built into Foote Bros. Maxi-Power Parallel Shaft Drives. Simple, balanced design, fewer moving parts, heavy duty construction, efficient lubrication and conservative ratings make Maxi-Power drives the logical choice for critical applications and severest operating conditions.

You can depend on Maxi-Power Drives to produce maximum performance with minimum attention because they're built for just that kind of service.

Write for Engineering Manual MPB . . .
has complete details and data. There's no obligation!

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Better Power Transmission Through Better Gears

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4559 SOUTH WESTERN BOULEVARD • CHICAGO 9, ILLINOIS

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Descaling Machines

Pangborn Corp., Hagerstown, Md., has announced the publication of Bulletin No. 609 which describes its line of Rotoblast descaling machines.

Photos, diagrams, cut aways and sketches show details and operating features of the wheels which provide the cleaning force of the mechanical descaling equipment. Various cabinet designs and material handling features appropriate to the type of work being descaled are described. The bulletin covers four-wheel and eight-wheel machines for descaling sheets, coils, and plates; special machines for descaling rods, bars, and wire; marginal descaling for pipe skelp; structural descaling equipment for angles, channels, H-bars, and I-beams; and special installations for descaling billets and slabs.

Flow Transmitter

A new, in-stream Chronoflo transmitter designed to eliminate stilling wells and expensive maintenance is the subject of a bulletin released by Builders-Providence Div., B-I-F Industries, Inc., Providence, R. I.

Designed specifically for water, sewage, and industrial waste applications, the in-stream transmitter, Model CTF-S, is for installation on Parshall flumes, weirs and other head-area devices for the accurate measuring of rates of flow in open channels. The new transmitter is in-stream actuated, and utilizes a unique type of float arrangement with the 6 in. expanded polystyrene float riding directly in the channel at the proper metering location. Float motion is vertical with no radial correction necessary.

Brushless Generators

Characteristics of high-speed, packaged brushless synchronous generators in 40 to 300-kw ratings which provide new dependability, minimum maintenance, constant voltage, and no sparking are described in a bulletin released by Allis-Chalmers, Milwaukee 1.

A combination of brushless excitation system and static voltage regulation control provides the key to the generator's design, the firm reports. In the excitation system, commutators and brushes are replaced by silicon rectifiers while the static voltage regulation system provides constant voltage output up to $\pm 1/2$ per cent regulation regardless of load or normal frequency variation.

Electro-Mechanical Parts

Sterling Precision Corp., Port Washington, N. Y., announces the distribution of its 512-page complete catalog featuring more than 20,000 electro-mechanical-components.

Included are precision gears, differentials, clutches, clutch brakes, as well as data on its expanded line to cover the needs of the entire precision electro-mechanical industry.

Robertshaw sets the pace with

PACKAGED BELLOWS

Don't lose orders...this single-source, cost-saving method can give you price and performance advantages your competitors can't match in equipment involving metallic bellows assemblies!

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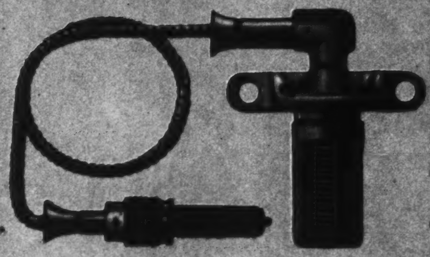
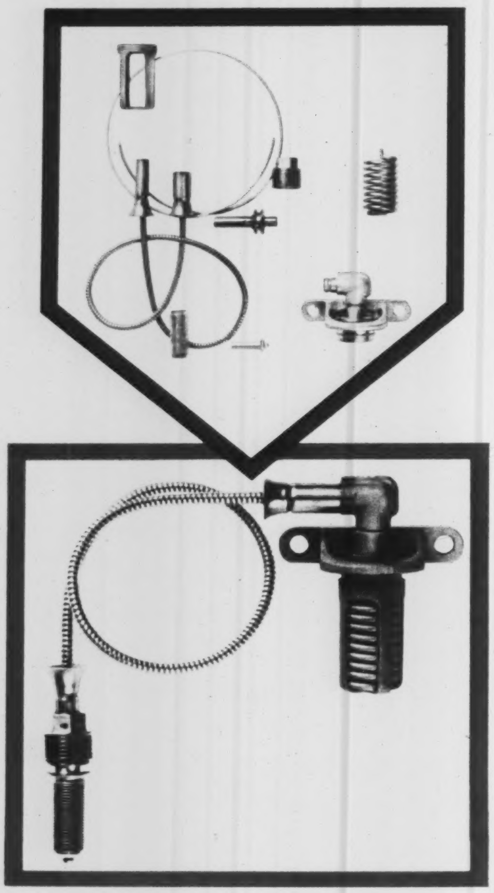


Robertshaw sets the pace with

PACKAGED BELLOWS

...from one source at one low cost!



In one custom-engineered, pre-assembled "package", you can now obtain hydraulically formed or welded metallic bellows and all assembly components from Robertshaw . . . at a definite saving. Packaged Bellows are designed, produced, assembled and tested right in our modern plant, and delivered to you ready for installation. You save on handling, assembling, inspections, testing and paper work.

No other bellows supplier can offer you such a wide range of bellows metals and alloys . . . including titanium, zirconium, Hastelloys, Inconel-X, Monels, stainless steels and all the standard bellows metals. Bellows sizes are available from miniature ¼″ O.D. up. If your applications require it, Robertshaw can supply Packaged Bellows for operation in the range of 1000°F plus and above 3000 psia pressure. Proper selection of metals, plus precision manufacturing, can also give you the resistance to corrosion and vibration that your tough applications demand.

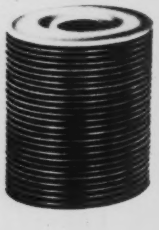
Bridgeport

Metal Bellows and Bellows Assemblies

Write for Bellows Bulletin 10 giving typical application data!

New **Robertshaw** FORMWELD BELLOWS

for premium performance!



Welded of any suitable weldable material, including many of the newer metals and alloys, to give you much greater adaptability to extreme environmental and service conditions. Closer control of bellows tolerances than ever before possible now assures greatly improved accuracy, predictable performance and longer life. Write for Bulletin 70!

Robertshaw Miniaturized BELLOWS

Save vital space and weight in aircraft, instrumentation and other equipment with hydraulically formed Robertshaw seamless metallic bellows as small as ¼″ O.D. and 5/16″ O.D. Custom-engineered in many metals to give you the exact characteristics you need. Write for Bulletin 10!

Robertshaw-Fulton

CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION · Milford, Connecticut

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Aluminum Bronze Bars

A four-page, two-color folder describing aluminum bronze bars is available from Johnson Bronze Co., New Castle, Pa.

The folder outlines the advantages of both solid and centrifugally-cast cored bars which are available in standard 12½-in. lengths and in sizes up to 8-in. od. Additional information is provided covering applications in gears, worms, worm wheels, valve seats, guides and others; physical properties and tolerances.

Heavy Checkweigher

A four-page folder describing the latest development in heavy duty, high speed checkweighing is announced by Toledo Scale Div., Toledo Scale Corp., Toledo 12, Ohio.

The literature illustrates and describes the features and advantages of the new Model 9460 automatic checkweigher. It is pointed out that this unit handles bags, boxes, packages, slabs, blocks, and other items, while in motion, within a weight range of 50 to 200 lb. The zone widths may be varied from approximately 2 to 8 oz, with a zone edge accuracy of $\pm 1/3$ oz.

Bronze Gate Valve

A completely redesigned and improved bronze quick-opening handy gate valve, designated as Fig. 430-58, is announced by Lunkenheimer Co.

The firm says the new valve provides tight shut-off against flow from either direction. It features a ball-and-socket joint between self-adjusting disk faces, and accurate grinding designed to assure flexibility for pressure-tight seating. A deep stuffing box effectively seals the operating stem while permitting easy operation, the company states.

End-to-end dimensions are unchanged. The cap is bolted down with two cap screws to ease disassembly and reassembly without injury to the valve.

Available in sizes ½ through 4-in. Fig. 430-58 valves are rated 75-lb steam pressure for water, oil, gas. They are especially recommended by the firm for installation where quick operation is required to handle water, oil and low pressure steams.

Valve Bases, Controls

Hannifin Co., Dept. 140, 501 S. Wolf Rd., Des Plaines, Ill., was issued Bulletin 235, covering alternate bases and the integral speed control section for its Series CC 4-way air valves.

The piping versatility obtainable with the new universal and gasket mounted bases is discussed, along with a discription of the integral speed control section and its operation. Dimensions and specifications for the new bases and control section are also included.

END WATER LEVEL WORRIES

in those medium pressure boilers

Here's the great combination that takes all the worries and troubles out of water level and feed pump control for the many medium pressure boilers—boilers with steam pressures up to 150 psi.

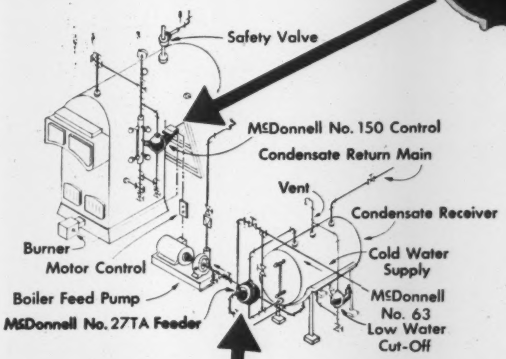
The drawing shows the simple hook-up. McDonnell No. 150 controls the boiler feed as it should be controlled—directly from the boiler water level. This holds the water level within the close limits that assure maximum steaming efficiency and fuel economy. Any deficiency in the returns is at once replaced by the McDonnell No.27TA Make-up Water Feeder installed on the receiver.

An extra switch on the No. 150 provides circuits for cutting off burner and sounding low water alarm—a final safeguard from emergency conditions such as current interruption in the pump circuit or failure of make-up supply.

Ask for engineering data covering all conditions. For boilers up to 250 psi. ask about the new 92 Series Pump Control.

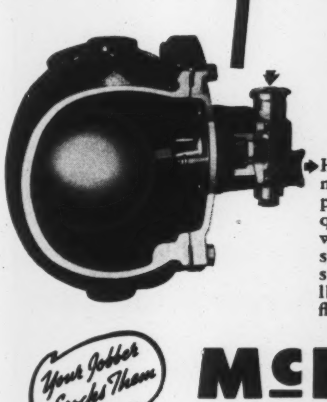
McDONNELL & MILLER, *Inc.*
3510 N. Spaulding Ave.
Chicago 18, Ill.

Doing One Thing Well — M&M SAFETY CONTROLS — REG. U. S. PAT. OFF.



McDONNELL No. 150 PUMP CONTROL

The most widely used, time proved control of its type—for boilers up to 150 psi. Underwriters' Listed. Has two mercury switches—one for controlling feed pump and one for low water cut-off and alarm. Packless construction features heavy monel sylphon. Switch leads have porcelain bead insulation. Also available with water column type body—No. 157.



McDONNELL No. 27TA MAKE-UP WATER FEEDER

Has large water feeding capacity which permits locating the No.27TA at a relatively low point on the receiving tank; this provides adequate space for return condensate, preventing wasteful overflow. Sturdy construction withstands turbulence in receiver. For tank pressures to 35 lbs., water supply pressures to 100 lbs. McDonnell Make-up Feeders also include flange-mounted types.

Your Jobber Stocks Them

McDONNELL
Boiler Water Level Controls

Boiler Water Feeders • Low Water Fuel Cut-Offs • Pump Controllers • Relief Valves
Flow Switches • Related Liquid Level Controls for Tanks, Stills, Air Conditioning Systems

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Horn Presses

Federal Machine and Welder Co., Warren, Ohio, has issued a 12-page bulletin, No. 52170A, that illustrates and describes the WARCO line of horn presses in capacities from 50 to 200 tons inclusive.

Extruded Metal Parts

A four-page bulletin treating the process of producing cold extruded metal parts, their physical characteristics, mechanical properties, economies, and applications is offered by Burgess-Norton Mfg. Co., Geneva, Ill.

Oil, Gas Burners

A six-page folder on its exclusive mechanical pressure atomizing oil and nozzle-mix gas burner has just been published by Boiler Engineering & Supply Co., Phoenixville, Pa.

Three full-page drawings describe construction features and principle of operation of the compatible combination oil and gas burner with which the Continental automatic package boiler is equipped. Flow of both main fuels and primary and secondary combustion air supplies are pictured. Flame monitoring and control systems are shown in detail and labeled for identification and instruction. The ignition system is also shown.

Metal Packings

A bulletin dealing with metal packings for pumps, engines, and compressors, has been published by Garlock Packing Co., 438 Main St., Palmyra, N.Y.

The 24-page booklet, designated Bulletin AD-166, contains data for correct selection, application, and installation of metal packing and it is complete with explanatory illustrations. The bulletin is designed specifically to acquaint users with pressure temperature and other service requirements relative to the various kinds of metal packing currently available.

Air Dehumidifier

Niagara Blower Co., 405 Lexington Ave., New York 17, has published Bulletin No. 140 describing its Hygrol air dehumidifier.

This apparatus uses a liquid absorbent for drying air to control its properties for industrial processing and product drying at low temperatures and the air conditioning of spaces for packaging and storage of moisture sensitive materials. The bulletin is illustrated with photographs of processing and air conditioning installations. Operating description and control method is illustrated by a diagram. Included is a chart of dehumidifying capacities at various temperatures and cfm of air handled.

Tube, Bar Stock

Shenango Furnace Co., Dover, Ohio, has issued Bulletin No. 156 offering information on standard bar and tube stock now available in three special materials: GC Meehanite metal, GA Meehanite metal, and Type No. 1 Ni-Resist.

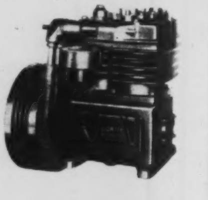
In addition to illustrating applications and outlining material features, the bulletin contains a comprehensive physical properties chart as an application guide. The firm reports the tubes and bars are ideally suited for the production of bearings, bushings, gears, liners, pump and valve parts, pistons, sleeves, sprockets, and many other common and special items.

low air pressure can
SABOTAGE
your plant production

Curtis protects... against it!

Air hammers, drills, sand blasts may be working...
but are they working at peak efficiency?
With the right Curtis compressor on the job, you
can be sure of an adequate and dependable supply of
compressed air at the proper pressure.

PRESSURE-UP YOUR TOOLS



The sealed, precision-built Curtis AIR COMPRESSOR delivers all the power your tools can use.

- Two-stage, air-cooled . . . 1 thru 50 H.P.
- Single-stage, air-cooled . . . ¼ thru 5 H.P.
- Timken bearings; pressure lubrication.

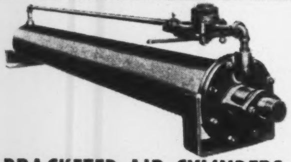
Tank-mounted compressors, ¼ thru 20 H.P. (1 to 95 cu. ft.).
Simple and base-mounted, ¼ thru 50 H.P. (1 to 217 cu. ft.).

PENDANT
AIR HOISTS

LIFT, LOWER...
PUSH or PULL...
UP TO 10 TONS

Movement smoother than human hands. Precise control. And precision Curtis manufacturing assures efficiency, long life; trouble-free operation.

C-65



BRACKETED AIR CYLINDERS
For horizontal or vertical mounting

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MANUFACTURING COMPANY
PNEUMATIC DIVISION
Write Dept. 44,
ST. LOUIS 20, MISSOURI

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Spiroid Gears

A 36-page comprehensive engineering manual covering Spiroid gears has been published by Spiroid Div., Illinois Tool Works, 2501 N. Keeler Ave., Chicago 39.

Information includes basic design requirements such as ratings, selections, center distances, bearing loads, mounting methods. The new manual contains photographs and drawings to illustrate the principle and application of Spiroid gears, a skew-axis gearing system for medium to high reduction ratios. Text includes sections on design advantages, applications, manufacturing, and dimensional design data.

Air Conditioners

An eight-page brochure, Bulletin 9127, describing the new, improved line of low pressure Inductor air conditioners for perimeter air conditioning of multi-room buildings is available from American-Standard Industrial Div., Detroit 32, Mich.

The brochure describes and illustrates outstanding construction and operating features. Tabular data presents such information as heating coil capacities, gravity heating capacity, hot water and steam heating capacity factors, and water friction for various delivery volumes.

Centrifugal Castings

The use of centrifugally cast cylinders in unfired pressure vessels, radioactive system service and other critical applications is the subject of a 16-page brochure prepared by Sandusky Foundry & Machine Co., Sandusky, Ohio.

Included in the report are 14 recent applications showing centrifugal castings made to ASME code-approved specifications (SA-216, SA-217 and SA-351) and military specifications MIL-S-18262A and MIL-S-867A. Pictured and described are stator shells, pressure vessels, nuclear test loop piping, atomic power reactor tubes and other centrifugal castings made by the firm to meet chemical, physical, testing, and inspection requirements of ASME Boiler and Pressure Vessel Code, Section VIII, Unfired Pressure Vessels.

Gas Scrubber

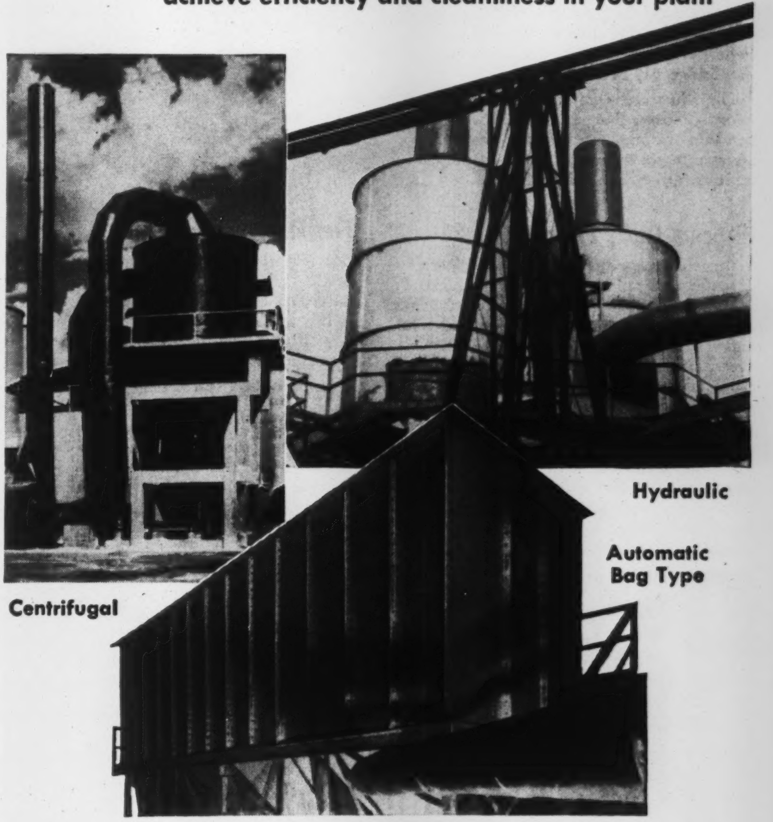
Peabody Engineering Corp., 232 Madison Ave., New York, has published an eight-page gas scrubber bulletin.

The brochure features high-efficiency, direct-contact gas scrubbers for removal of particulate matter, including sub-micron dust and fume, and absorption of gases and vapors. The scrubbers clean, cool, and absorb simultaneously. Capacities range from 100 to 250,000 cfm. Slurries used for scrubbing liquid are handled readily by unique selective agglomerating and cleaning stages. Both stages are within a single shell.

Get rid of dust!

It's expensive!

Norblo Dust and Fume Collection helps you achieve efficiency and cleanliness in your plant



Any dust or fume condition can slow down employee performance, increase spoilage and industrial accidents. All of which costs money – and *increased operating and maintenance costs.* Norblo helps you to achieve outstanding efficiency in dust and fume collection – helps you to avoid these costly factors economically.

Norblo's valuable experience of almost 50 years in three principal dust collection methods is widely recognized in industry. The Norblo patented Centrifugal system is often installed in combination with the Norblo Hydraulic Collector or Norblo Bag Type Collector – the most imitated *automatic* bag type dust arrester.

High recovery with low operating and maintenance costs is the record of Norblo dust and fume collection installations. Ask your consultant, or write direct for information about Norblo *guaranteed* performance.

The Northern Blower Company
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Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

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Expansion Joints

A six-page bulletin on S-R expansion joints is available directly from Expansion Joint Div., Badger Mfg. Co., 230 Bent St., Cambridge 41, Mass.

The illustrated bulletin contains general information on flanges, liners, covers, temperature ratings, and other material of interest to joint users. A list of the firm's representatives also is included.

Platinum-Group Products

An eight-page general brochure briefly describes the platinum-metal products of Metals & Controls Div., Texas Instruments Inc., Attleboro, Mass. Included are solid and clad platinum metals and alloys in sheet, strip, wire, foil, and seamless tubing; parts, shapes, and specialties; dental foil, electrical contacts, electrodes, gauze, catalysts, salts and derivatives, expanded anodes, laboratory ware, rhodium plating solutions, transistor materials and thermocouple wire. Services offered are smelting, residue preparation, sampling, assays, refining, and chemical analysis.

Stainless Tubes

A new data card published by Tubular Products Div., Babcock & Wilcox Co., Beaver Falls, Pa., describes the properties of Croloy 25–20 (TP310).

The chemical composition, size ranges, and short time high temperature tensile and rupture properties of this stainless tubular material are discussed in the bulletin, identified as TDC-195.

Flexible Couplings

A recently revised bulletin on roller chain flexible couplings, Bulletin 597, has been published by Chain Belt Co., Milwaukee.

The bulletin outlines the advantages that are wanted and needed from a flexible coupling including: simple, all-steel construction that assures long life and maximum service; accommodation of angular and parallel misalignments with minimum backlash; and easy installation or removal. In addition, the bulletin carries information on how to properly select Rex flexible couplings and illustrates installation and maintenance procedures.

Submersible Pumps

Layne & Bowler, Inc., Memphis 8, Tenn. has released a new bulletin on submersible pumps, No. 202.

Detailed cross section drawings plus illustrations of the many and varied uses and applications of Layne Submersible Pumps make up the bulletin. Applications covered include: plant water systems, irrigation, reservoir pumping, municipal primary water supply.

Safety, Control Valves

Whalen, Inc. published Catalog 789-59 covering three basic types of valves, Series 7, 8, and 9.

Operation of Series 7 valve is internally controlled and eliminates all pulsation, vibration, fluttering, chattering and mechanical shock. Both Series 8 and 9 valves can be opened or closed automatically, or manually, from any remote location, actuated by pilot control from line operating pressure, an independent pressure supply, or mounting external accessories or regulator equipment.

Available in ASA and API types in $1^1/_2$ through 16-in. sizes.

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WIRE FORMS—SPRINGS and METAL STAMPINGS

D-&-B Parts deliver top performance at lower cost! Years of KNOW-HOW and quality control guarantee Wire Forms, Springs and Stampings that are easily assembled . . . withstand stress . . . and perform under the most trying conditions!

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ADVANCE SPRING CORPORATION (a division of Dudek & Bock)
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BUY DIRECT! SAVE AT PALLEY'S

A. AS LOW AS 56.75

B. 20.75 AND UP

NEW PALLEY HYDRAULICS

Here are two of our newly developed line of double action Industrial Hydraulic Cylinders. These cylinders are designed to meet the most rigid requirements of industry. All are heavy duty steel.

Type (A) is a heavy duty, press type cylinder with bores of 3", 5", 6" and 8" – thrust ranges up to 75 TONS at 3000 PSI.

Type (B) is an internal cap type cylinder with bores of 1-1/2", 2", 2-1/2", 3", 3-1/2" and 4". Has a thrust range from 2" to 48". Delivers up to 18,850 pounds thrust on 1500 PSI line pressure.

For COMPLETE LISTING of our tremendous ON-THE-SHELF stocks and prices – Send for Cat. No. H-59

ELECTRIC HYD. MOTOR PUMP AS LOW AS $115

Motor designed to face mount any Aircraft type Hydraulic Pump. Made to meet the most rigid requirements of industry. For continuous duty with a high starting torque. Available in 115/230 V, 1 phase or 220/440 V, 3 phase – 60 cycle AC. Sizes from 3/4 to 15 HP. Pressures up to 3000 PSI. Write for Cat. H-59 for complete information and other Bargains.

21 TO 1 SPEED REDUCER

Precision built for Army Gun Control Mechanism. Gear ratio gives approx. 90 RPM with direct drive 1750 RPM motor. Can be belt driven with up to 1/2 HP motor. Has ball bearings throughout. Will operate conveyors, timing devices, etc. 21 to 1 gear ratio. 14.75

NOTE: Many other gear Bargains in stock. Write for Catalog Supplement H-59.

GRAVITY CONVEYOR

Has 500 lb. per ft. capacity. 12" wide curved steel frame with guard rail. 5 rows of 2" dia., 5/8" face ball bearing steel wheels. Unit is 45° ACR on 35" center line radius. Each unit couples to next at ends. Unused, excellent condition. 14.95 EA.

HYDRAULIC REMOTE CONTROL MASTER & SLAVE

When connected with 1/4" tubing these units act as a precision, remote power transmission unit. Moving master handle causes the slave arm to respond in exact ratio to the master. Ideal for remote machinery controls. Both units (used) No. H-EX-1SU 27.50

SAVE up to 85% on HYDRAULIC Valves, Pumps, Cylinders, Motors, etc.
We have the Largest On-the-shelf stocks in the country. Write for Cat. H-59

Palley's

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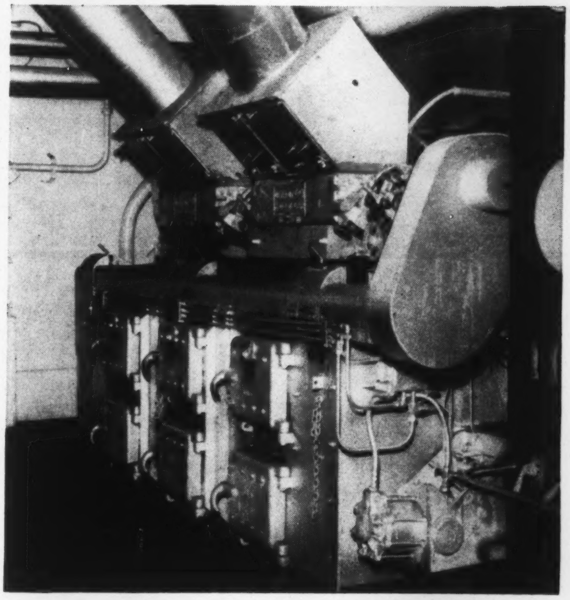
Launching of the Edmund Fitzgerald—largest ship on the Great Lakes. Length 729 ft., beam 75 ft., depth 39 ft., Ore cargo capacity 26,000 gross tons. Owner, The Northwestern Mutual Life Insurance Co. Builder, Great Lakes Engineering Works, at its River Rouge, Mich., yard. Charterer, Columbia Transportation Division of Oglebay Norton Co.

(Wide World Photo)

SS EDMUND FITZGERALD . . .

the 61st Ship equipped with

DETROIT STOKERS



One of 2 Detroit RotoStokers Type CC firing 2 Combustion Engineering Co. bent tube marine boilers in the Fitzgerald. Each boiler is rated at 32,750 pounds steam per hour MCR—36,000 pounds per hour peak. Operating pressure is 470 psig. Total steam temperature is 755°F. Design is for 12,350 BTU bituminous coal with 11.9% ash.

The Str. Edmund Fitzgerald, with Detroit RotoStokers Type CC (continuous cleaning), is the 61st ship in 10 of the Great Lakes fleets to be equipped with Detroit Stokers.

These ships burn coal because it is the most economical fuel . . . burn it on Detroit Stokers because of their high efficiency and dependable operation.

Dependability is important anywhere . . . doubly so on ships where failure at a critical moment would be serious. Stoker efficiency is a first concern of cost conscious ships' crews who compete for operating economy records.

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For the same kind of superior stoker service and economy that was chosen for this giant steamship, let us survey your plant and give you recommendations—without obligation.

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Inquiries should be forwarded to Mr. Donald Sweet, Engineering and Executive Placement, Government Equipment Division, Raytheon Company, 624-I Worcester Road, Framingham, Mass.

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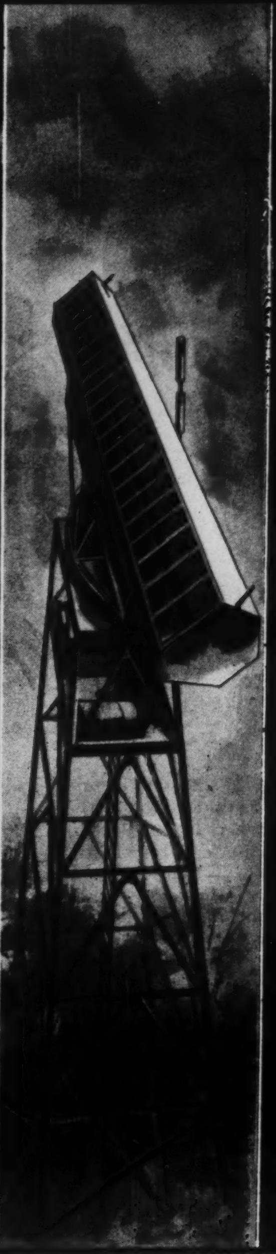

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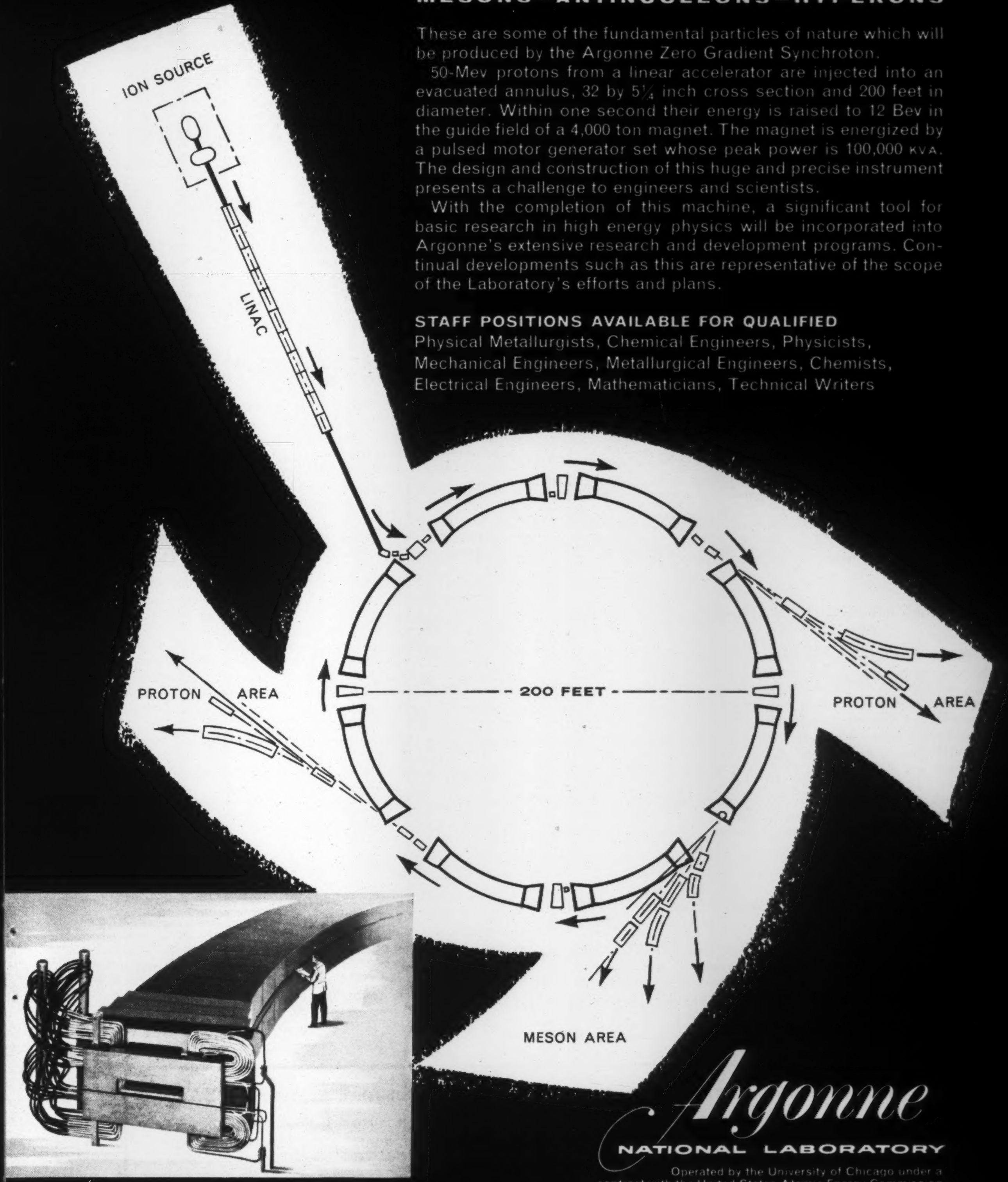

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POWER BOILERS (Section I) 1959 Edition $5.00

This code gives minimum requirements for construction of power boilers to be used in stationary service. Stationary boilers as herein considered include portable and traction boilers in which steam is generated for use, external to the boiler, at a pressure exceeding 15 psi. Rules apply to the boiler proper, piping connections up to and including the valve or valves as required by the Code; superheaters, economizers, and other pressure parts connected directly to the boiler without intervening valves.

CONTENTS: Selection of Materials. Minimum Thickness of Plates and Tube Sheets. Tubes and Pipe. Rules for the Fusion Process of Welding. Construction and Maximum Allowable Working Pressures for Steam Power Boilers. Boiler Joints. Ligaments. Domes. Dished Heads. Flat Heads. Braced and Stayed Surfaces. Tube Sheets of Combustion Chambers. Headers. Hydrostatic Deformation Test. Cutting of Plates. Tube Holes and Ends. Riveting Calking. Access and Inspection Openings. Nozzle Openings. Safety Valves. Water and Steam Gages. Fittings and Appliances. Setting. Hydrostatic Tests. Stamping. Appendix Containing: Examples Illustrating General Method of Calculating Efficiency of Riveted Joints. Tables Showing Allowable Loads on Staybolts and Round Stays. Method of Checking Safety-Valve Capacity. Dimensions of Cast Iron Pipe Flanges and Fittings. Recommendations for Fusible Plugs. Standard Practice for Making Hydrostatic Tests on a Boiler Pressure Part. Suggested Rules Covering Existing Installations. Strength of Materials. Examples of Methods of Computing Openings in Shells. Examples of Computing Allowable Loading on Structural Attachments to Tubes. Approval of New Materials Under Code. Maximum Allowable Working Pressures—Thick Shells. Steel Casting Inspection and Marking Requirements for Higher Quality Factor. Basis for Establishing Stress Values. Specimens of Data Report Forms.

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This section contains the material specifications adopted for boilers and pressure vessels built under the code rules. Specifications for ferrous material include steel pipe, tubes, castings, bolting materials, bars, billets and forgings, boiler plates and rivets, forged or rolled pipe fittings and welding fittings, corrosion resisting and heat resisting steels, welding electrodes and rods, wrought iron, cast iron, cast nodular iron, and malleable iron. Methods and definitions for mechanical testing of steel products are also given. The specifications for nonferrous materials include aluminum and aluminum-base alloys; copper and copper alloy plate, sheet, strip, rod, bar, shapes, pipe, tubes, castings, and filler metal; nickel and nickel-alloy plate, sheet, strip, rods, bars, wire, pipe and tubing; welding electrodes and rods.

LOW-PRESSURE HEATING BOILERS (Section IV) 1959 Edition $1.25

These rules cover minimum construction requirements applicable to steel plate and cast iron boilers for operation at pressures not exceeding 15 psi gage, to steel plate hot-water heating and hot-water supply boilers and cast iron hot-water boilers to be operated at pressures not exceeding 160 psi or temperature not exceeding 250 F.

MINIATURE BOILERS (Section V) 1959 Edition $1.00

The construction rules, welding and inspection requirements and directions for stamping and recording data in this code apply to fired pressure vessels, fired and unfired boilers which do not exceed the following limits: 16 in. inside diameter of shell, 5 cu. ft. gross volume, 42 in. over-all length of outside to outside of heads at center, 20 sq ft water heating surface, and 100 psi maximum allowable working pressure.

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UNIFIRED PRESSURE VESSELS (Section VIII) 1959 Edition $6.00

This code covers minimum construction requirements for the design, fabrication, inspection, and certification of unfired pressure vessels. It is divided into the following three sub-sections: A, covering the general requirements applicable to all pressure vessels; B, giving the specific requirements applicable to the various methods used in the fabrication of pressure vessels (welded, riveted, forged, and brazed methods, respectively); C, providing specific requirements applicable to the classes of materials used namely, carbon and low-alloy steels, nonferrous metals, high-alloy steels, cast iron, clad and lined material and cast nodular iron. Supplementing the code rules are design formulas, rules for bolted flanged connection, porosity charts, charts for determining shell thickness of vessels under external pressure, and a considerable amount of useful non-mandatory information.

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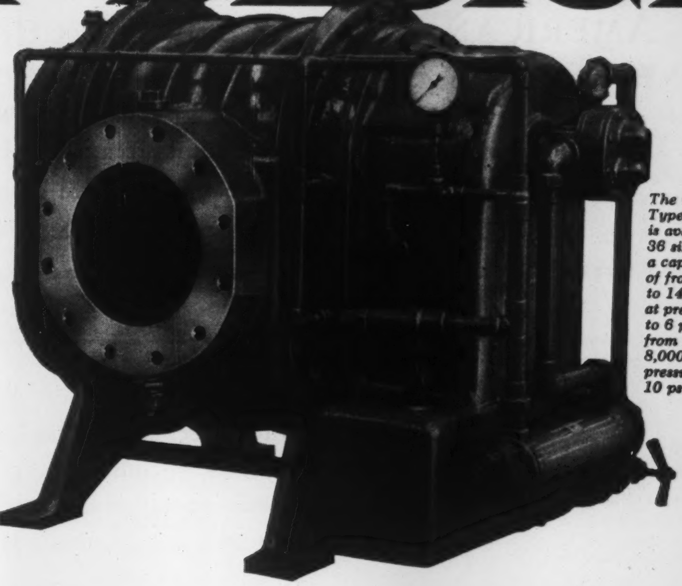
R-C blower delivers more CFM



The new R-C Type RAS Blower is available in 36 sizes covering a capacity range of from 2,000 to 14,000 cfm at pressures to 6 psig and from 1,500 to 8,000 cfm at pressures to 10 psig.

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Roots-Connersville RAS blowers offer many advantages—exclusive rotary positive design, ease of installation, efficiency of operation, and long years of trouble-free service. These features are the result of R-C's specialized experience of more than 100 years in the design and application of air and gas handling equipment.

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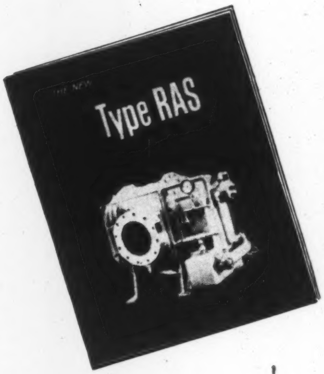

For additional data, please refer to pages 565-568 in **Chemical Engineering Catalog,** *our section in* **Mechanical Catalog,** *or write for* **Bulletin RAS-158.**

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Expansion Joint Design Moves out of the "Model T" Era

Badger first began fabricating packless metal bellows expansion joints more than 35 years ago. These "Model T" joints performed (and are still performing) with outstanding success in hundreds of process and steam line piping installations.

Starting in the 30's other expansion joint manufacturers entered the field. The most successful adopted many of the basic features of the original Badger design.

During the last decade, as industry's requirements became more stringent, and joint manufacturers gained fabricating and field experience, certain fundamental problems inherent in the early designs became evident. Most of these problems were solved through a series of modifications. (Among which was the Badger Directed Flexing Self-Equalizing Joint — the famous "DFSE" Design.) But, at best, the modifications were stop-gap measures which complicated the joints and greatly increased their weight. A fundamental reassessment of expansion joint engineering data was needed. Badger led the way: In 1956, a task force completed a three-year research program and the first S-R (Service-Rated) Expansion Joints were produced.

In the three years they have been available, S-R Expansion Joints have been both an engineering and a sales success. But like many revolutionary concepts which upset tradition, the full implication of the advantages S-R Joints offer is still not universally understood. The message that follows is an attempt "to set the record straight."

• • • • •

Equalization — fact and fiction

Many users of expansion joints are under the impression that the so-called "equalizing" rings on today's conventional type expansion joints distribute movement equally among all the corrugations of the bellows. It is argued that as the joint absorbs thermal movement, the tops of the rings progressively come into contact until the bellows is fully compressed thus limiting the amount of compression which any one corrugation can ultimately absorb (see diagram 1). In *this* sense the rings do contribute to the "equalization" of movement by physically limiting the compression of each corrugation to the distance between any two adjacent rings.

Note, however, that the degree of compression will not be truly equalized until the tops of all the rings are in contact. But, when such a condition occurs, serious problems will result. If the limit of compressibility is reached before the thermal expansion has been completely absorbed, exceedingly large forces will be transmitted through the pipe line to the anchors and connected equipment. On the other hand, if the joint is compressed only partially, not all of the corrugations will absorb movement to the same degree.

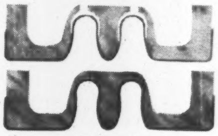

Diagram 1

Conventional Type Expansion Joint. Cross-sections of rings and bellows of a conventional "self-equalizing" joint showing cold and hot positions. Note that true equalization of movement can only be obtained when tops of all rings are in contact — an impractical and dangerous situation.

How S-R Joints solve equalization problem

Badger S-R Expansion Joints feature the new Curvilinear Corrugations which naturally assume an "all curve" shape under pressure (diagram 2), assuring more equal distribution of stresses throughout the bellows material. Furthermore, the shape, height and pitch of the corrugations are based on a carefully engineered correlation. Thus, reasonably equal distribution of movement among the corrugations is obtained, even in joints not equipped with reinforcing rings.

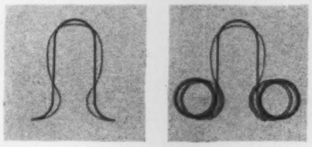

Diagram 2

Badger S-R Expansion Joint. Cross-sections of S-R Joints (Series 50 left, Series 150 right). The movement of the corrugations is shown by dotted and solid lines. Compare configuration and effective height of corrugations, position and size of rings with conventional joint.

Equalization of movement is inherent in the design and functioning of the bellows on Badger S-R Joints. On the basis of provable engineering criteria, the prime purpose of reinforcing rings of any design is to retain the hoop dimension (diameter) of the corrugations when they are subject to internal pressure. This Badger's simple, lightweight tubular reinforcing rings do. But, in addition, the new tubular shape of the rings does contribute to joint flexibility and life by permitting flexing over a more effective portion of the total corrugation height than conventional cast or fabricated equalizing rings.

Better performance, lower cost

Briefly, then, Badger S-R Joints alone offer these advantages: Better equalization of movement which results in elimination of localized stresses and leads to longer joint life; a simple, lightweight design that makes installation easier, eliminates cumbersome castings and fragile mechanical devices; complete range of sizes from 3" to 72" made from any workable metal and with a wide choice of accessories.

Badger S-R Joints are probably the answer to your problem. There's an easy and quick way to find out — ask the Badgerman for his recommendations. Write or phone today. Badger Manufacturing Co., 230 Bent St., Cambridge, Mass.

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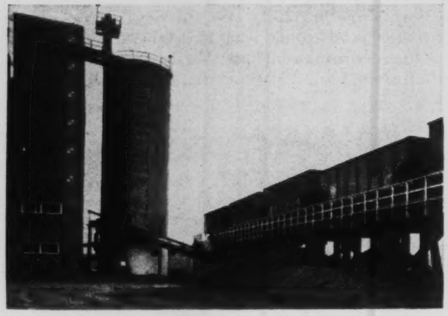
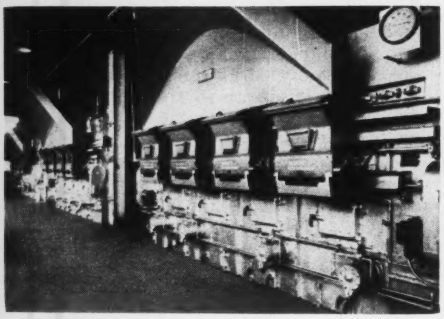
BADGER S·R
EXPANSION JOINTS



At delivery point, coal moves by belt conveyor to bucket elevator which carries it to roof of plant. Here reversible screw conveyor delivers coal either to 430-ton silo or coal bunkers inside plant. Conveyors and silo by Fairfield Engineering Co. Outside storage is under trestle at right.



Looking down firing aisle at three Babcock & Wilcox 75,000 lb/hr boilers. Coal is gravity fed from bunkers through Stock Equipment automatic scales and nonsegregating distributors to 4-unit Detroit Rotostokers.

Over coal bunkers. Roof screw conveyor moves coal to chute (left). Coal is then dropped to screw conveyor shown and is carried to any of three 100-ton storage bunkers underneath.

Coal sets pattern for low-cost steam

Fabric finisher burns coal for economy and availability

Modernity is the keynote of the new plant of Carlisle Finishing Co., a division of Cone Mills Corporation, Carlisle, S.C. Advanced planning and up-to-date techniques are evident throughout the company's entire operation.

The power plant, too, reflects this thinking . . . *coal* is used to generate the steam required for heating and processing. Chosen for its economy and availability, coal is burned and handled automatically by the latest equipment for peak efficiency. Also, the interior of this plant—designed by the consulting firm of J. E. Sirrine Co., Greenville, S. C.—has been decorated in cheerful colors to match the cleanliness of operation.

Coal is lowest cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% *more* steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

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To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

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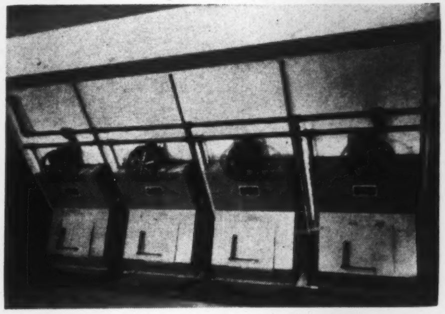

Ash hoppers below furnaces drop ashes into sluice line for disposal. Ash handling system by United Conveyor Co. Fly ash from Western Precipitator collectors is reinjected by high velocity air.

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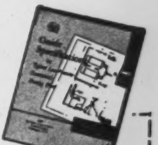

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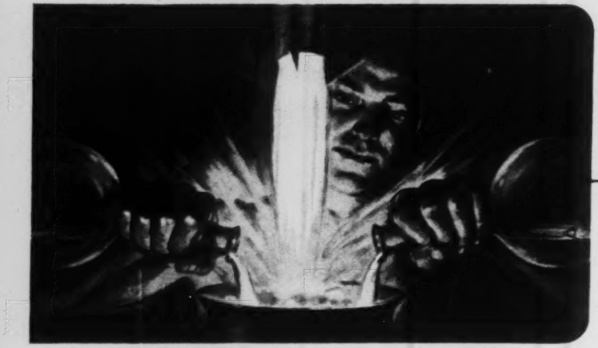
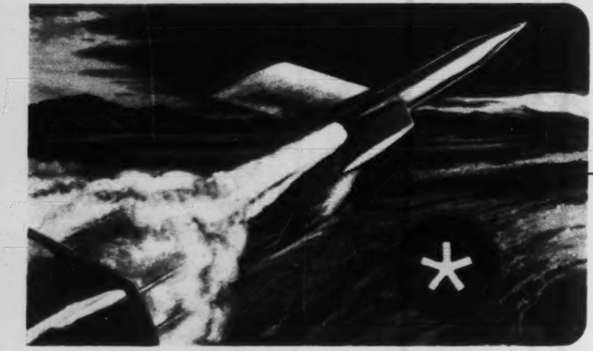
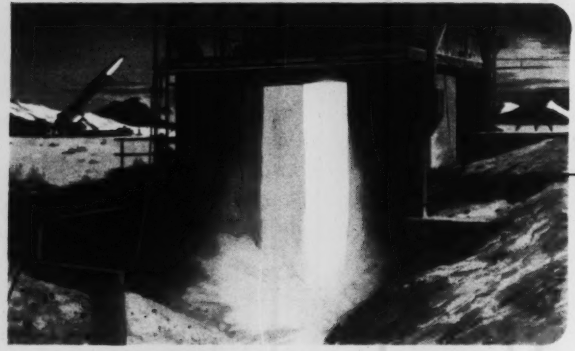
Pioneering Achievements in Rocketry at JPL



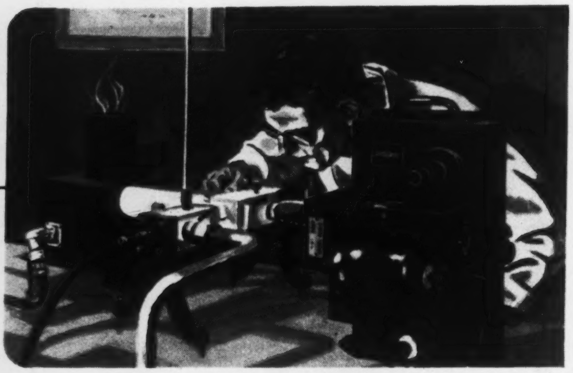
LIQUID PROPELLANT SYSTEMS... were pioneered at JPL. Development work began in 1943 and led to the first practical rocket power-plant in the United States in which spontaneous ignition took place upon mixing of the oxidizer and fuel.



SOLID PROPELLANT SYSTEMS... received momentous impetus in 1947 with the successful flight of the Thunderbird, a test rocket. This JPL pioneering achievement demonstrated a new technique which has since revolutionized the field of solid propellant rockets.

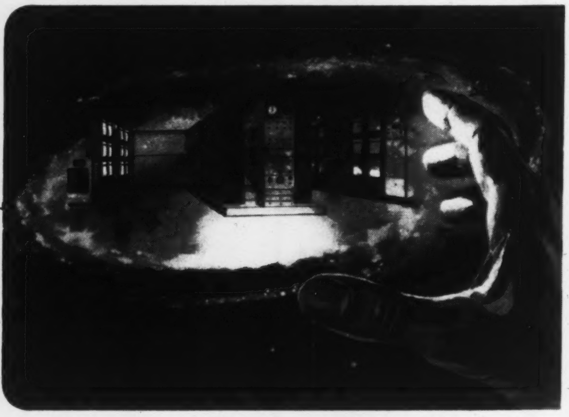


DEVELOPMENT . . . of efficient rocket power plants involves large scale testing and the application of knowledge from many scientific and engineering fields—thermodynamics, combustion, heat transfer, fluid mechanics, and metallurgy.



HEAT TRANSFER . . . studies at JPL with a camera using a Kerr cell shutter taking photos at 20,000 frames per second were the first high-speed, high-resolution motion pictures successfully recording the action of nucleate boiling.

MATERIALS RESEARCH AND TESTING . . . is one of many supporting research programs under way at the Laboratory and are considered a "must", in providing needed data for engineers concerned with the design and development of propulsion systems.



TESTING . . . of rocket engines resulted in the establishment of a center for recording rocket engine measurements when in 1948 the Lab established the first system serving five engine test cells. This has now expanded to a complex multi-channel system.

jpl

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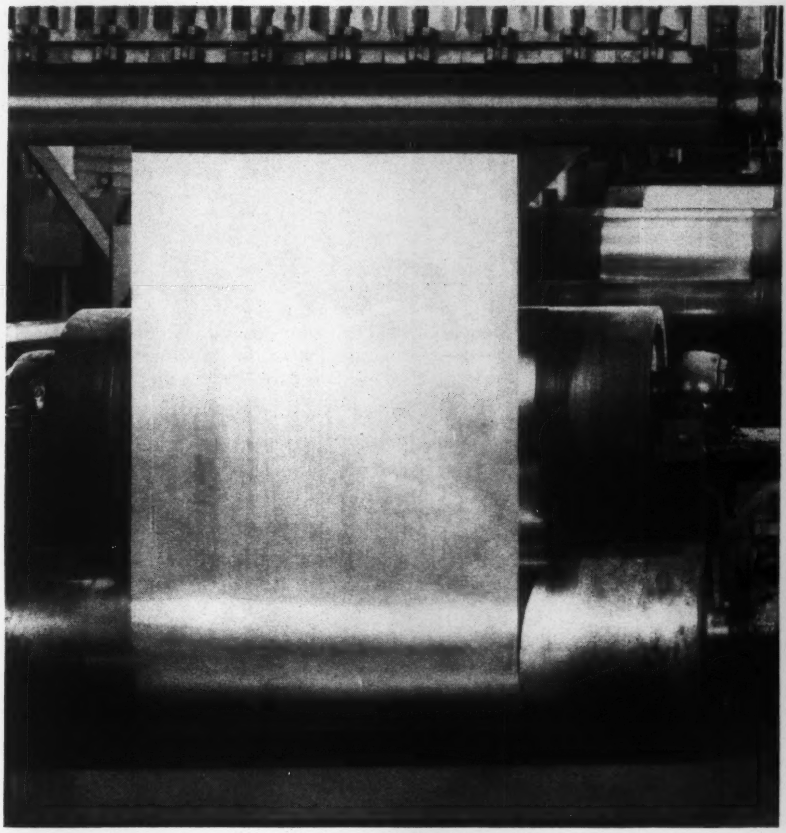

Here, the strip enters the furnace section of the line, under positive alignment and control as provided by the USS Continuous Strip Tracking System.

Continuous annealing line, Kaiser Steel Corp., Fontana, Cal.

A USS Continuous Strip Tracking System like the one recently installed at Kaiser Steel's Fontana plant speeds up tin plate production because it *prevents* mis-alignment, rather than trying to correct it after it happens.

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Processing lines using the Continuous Strip Tracking System turn out strip that is more uniform from coil to coil. This system can process fragile light-gauge strip at elevated temperatures and at speeds not possible with any other type of guiding methods.

United States Steel's Strip Tracking System works equally well in either ferrous or nonferrous metal processing lines. For more information, send in the coupon.

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City .... State ....

(Please Print)

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C. D. Boyce

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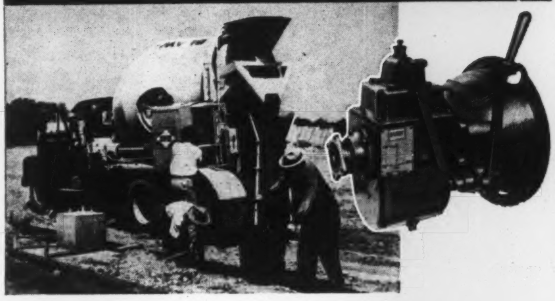

On this Blaw-Knox truck mixer, FUNK-designed units handle an unusual job in a simple way. Speed and flexibility were gained with a 3-speed synchro-mesh transmission having overdrive and underdrive. A space and alignment problem was solved by the unique design of the heavy-duty clutch case that enables the transmission to be offset at a 20° angle.

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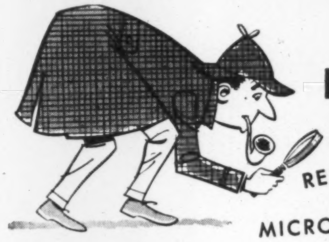

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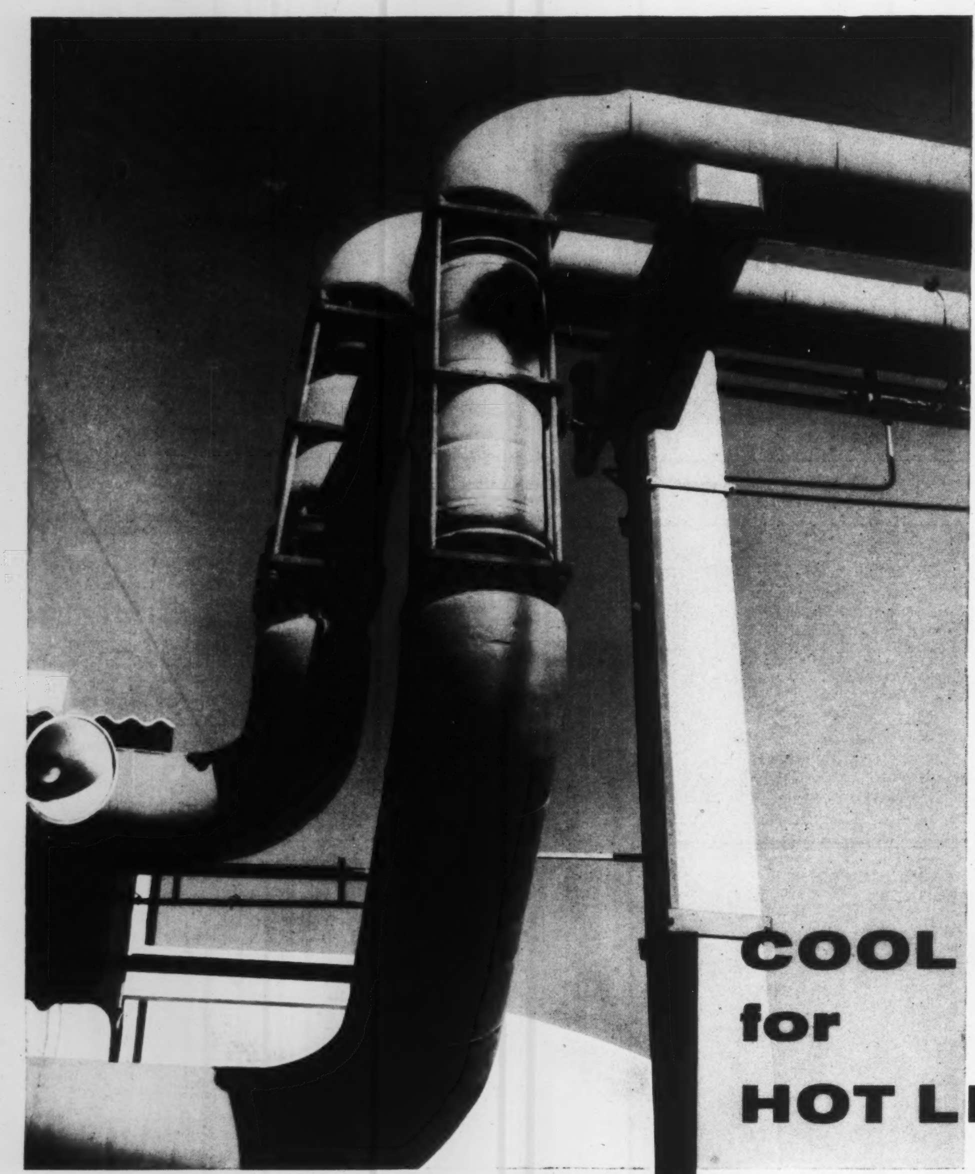

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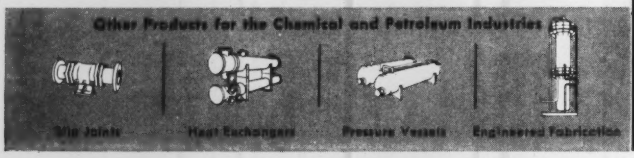

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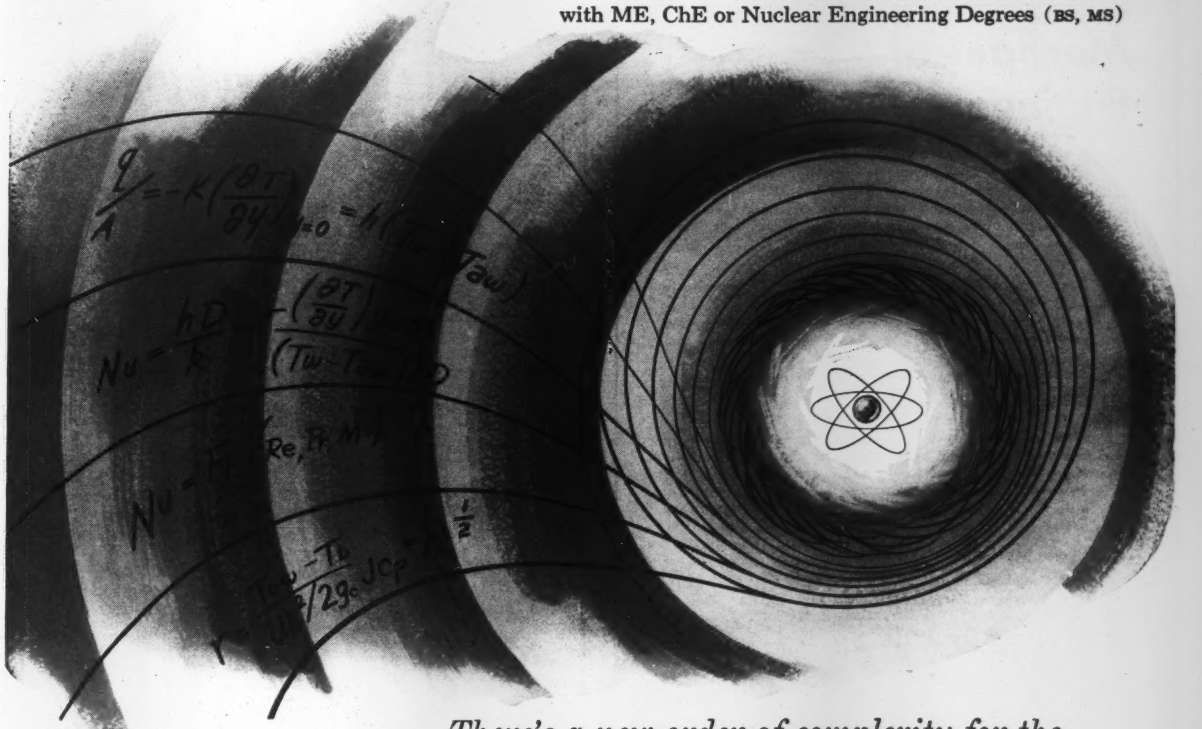
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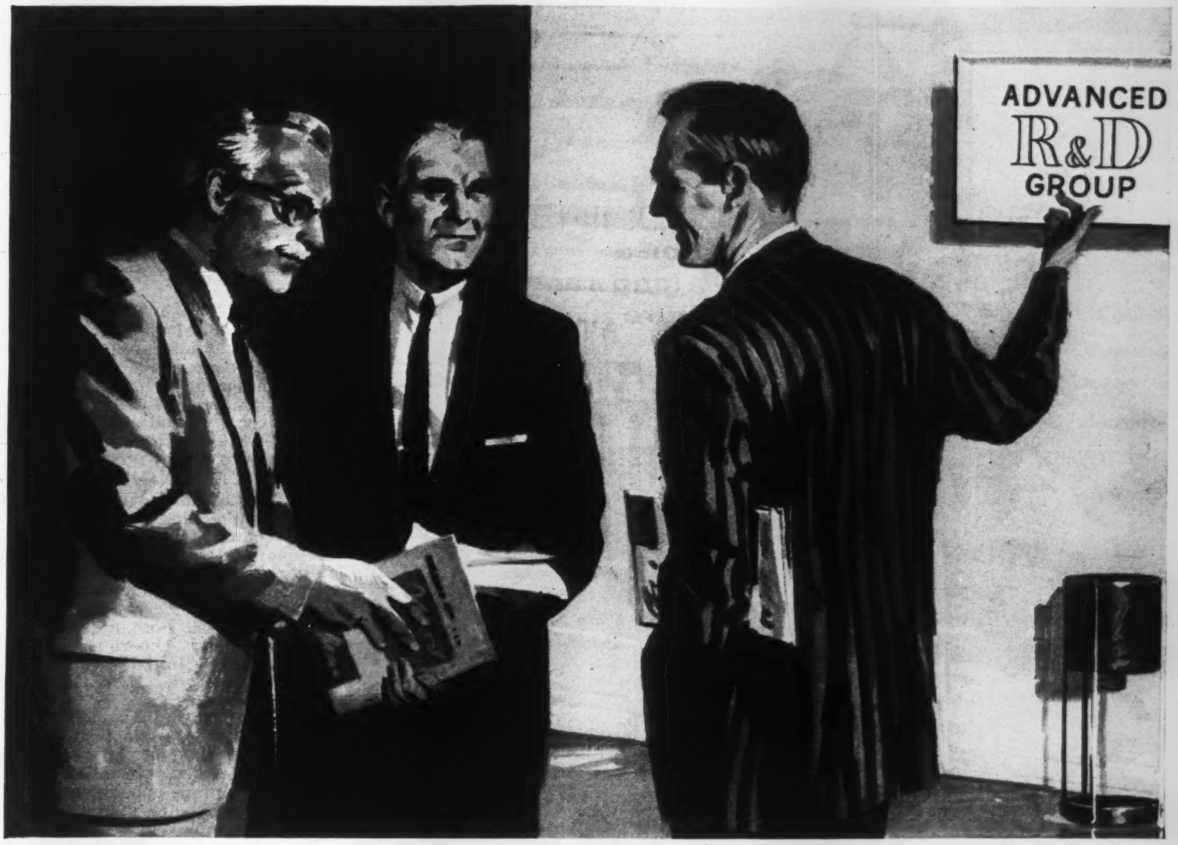

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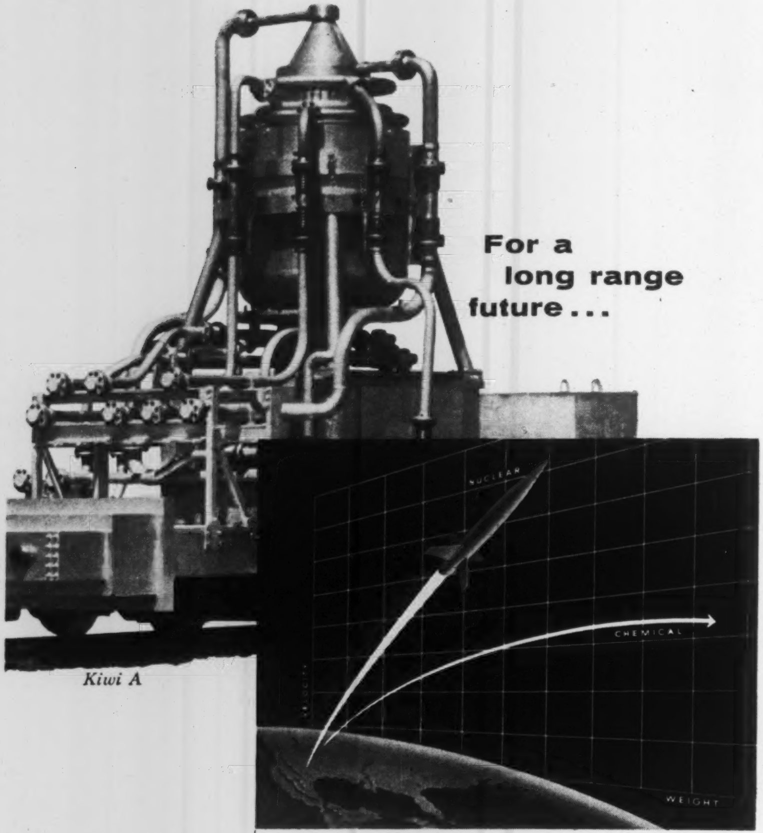

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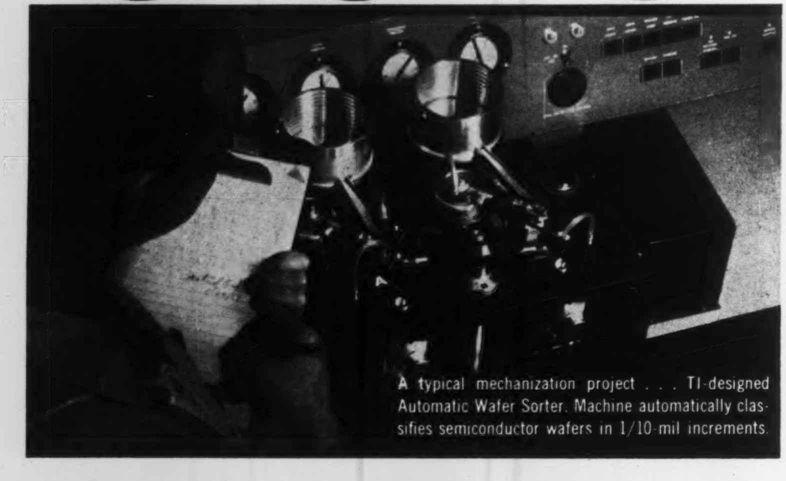

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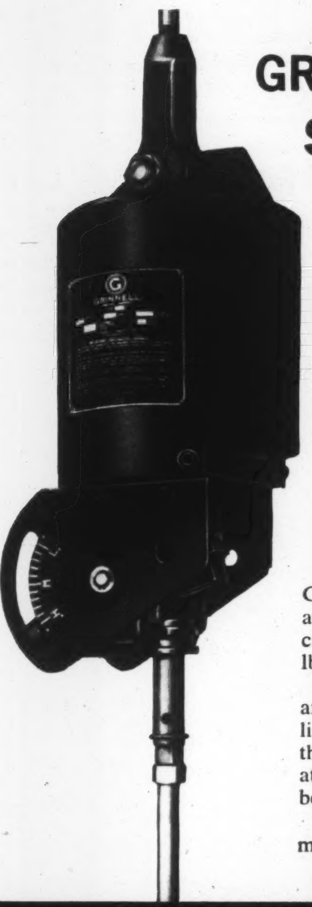

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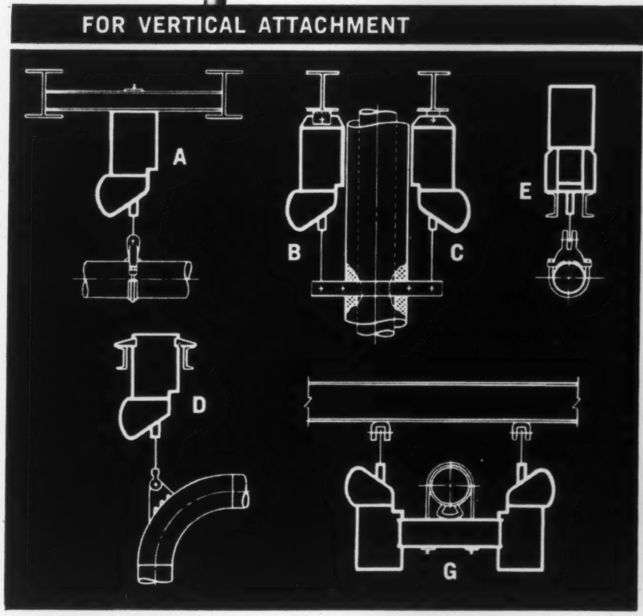

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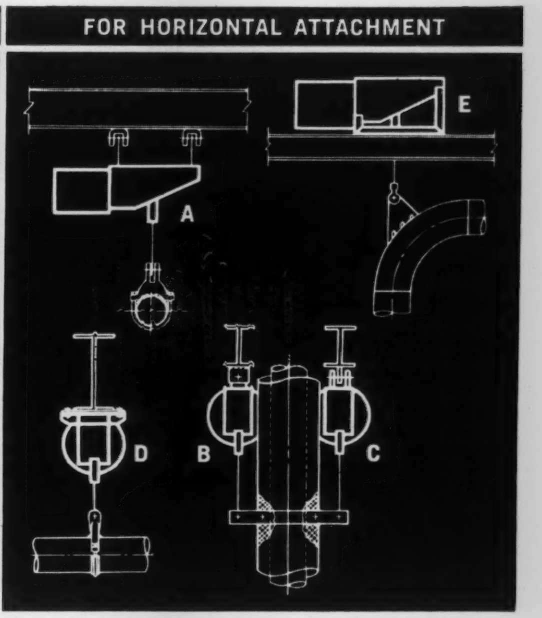

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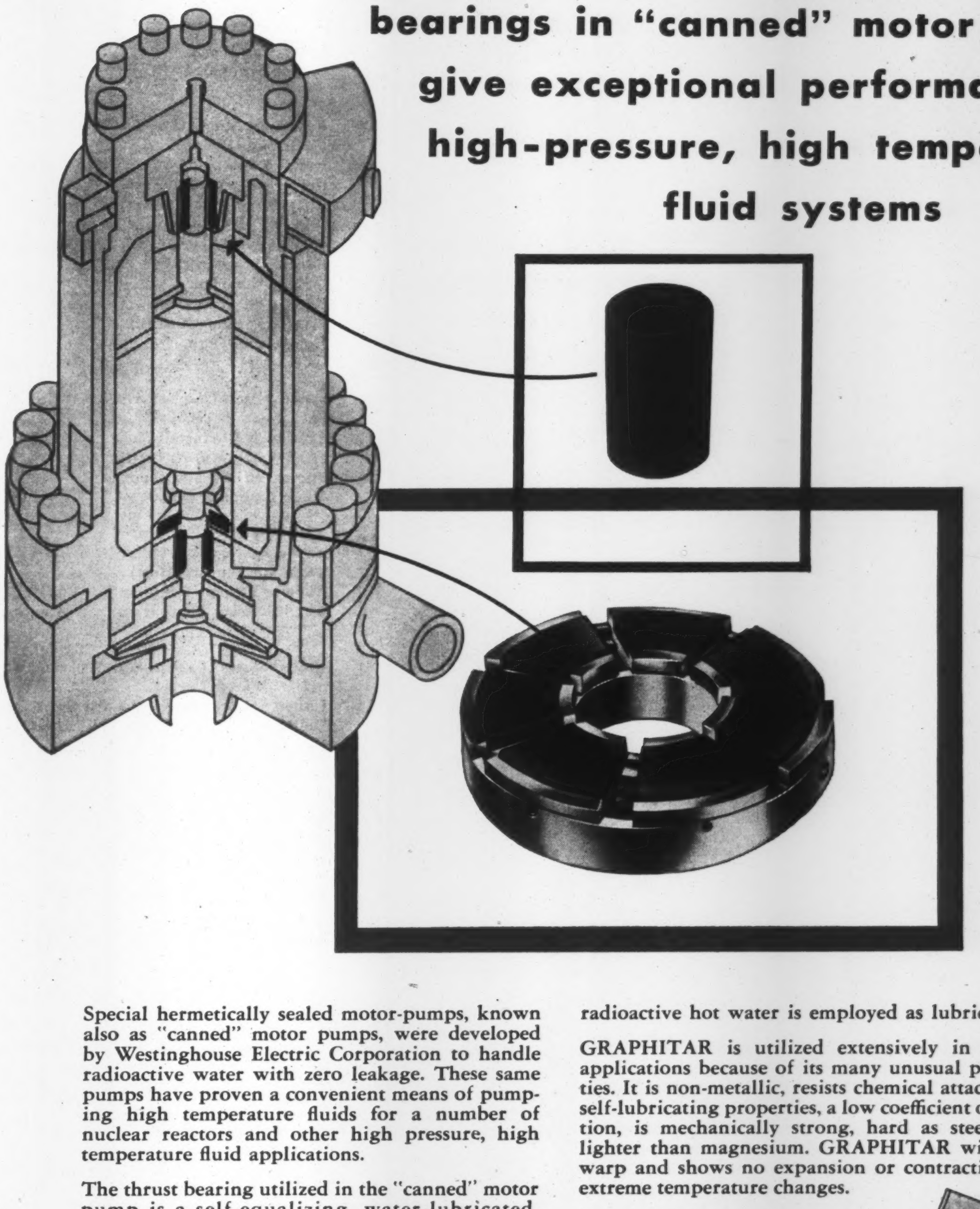

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*Aerovent Fan Co.
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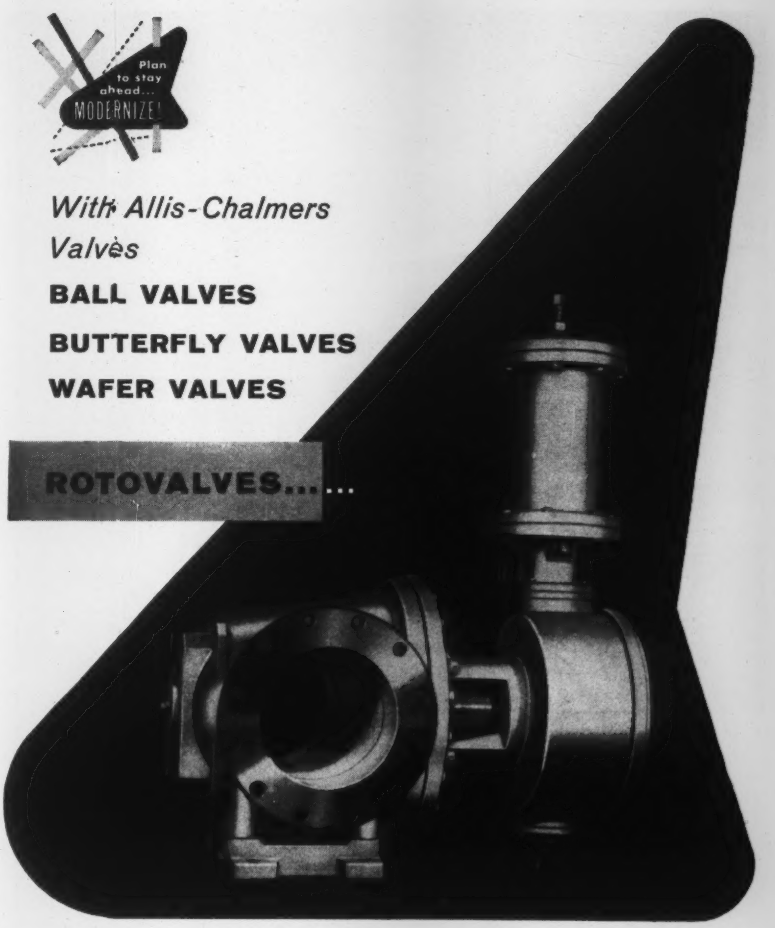

Rotovalves have a flexibility that makes them suitable to any type of operation, with any method of control, in any location. Only Allis-Chalmers Rotovalves give you all these features:

Greatest Rangeability — In A-C Rotovalves, rangeability is greater than 150 to 1.

Least Pressure Loss — Full-line opening means less head loss, lower operating costs.

Easiest to Operate — Hydraulic imbalance and mechanical design make it easy for one man to close the valve as fast as is required. Less power is needed in mechanical or electrical operation.

Greatest Initial Shut-Off — Rotovalve is 55% closed at 25% stroke, and 92% closed at 50% stroke. In comparison, gate valves are only 18% closed at 25% stroke and 43% closed at 50% stroke.

Most Controlled Closing Time — Closing as quickly as 1/10 second or as slowly as needed. Fast initial closing limits reversal of flow.

Most Positive Closing — Drop-tight, positive closing. Self-purging, monel-to-monel seating. Pressure-tight bolted head, easily-repacked stuffing box, and machined and lapped seats are additional features.

For information on the complete line of Rotovalves, and butterfly, ball and wafer valves, contact your nearest A-C valve representative, or write Allis-Chalmers, Hydraulic Division, York, Penna.

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1101

for built-in OEM drives, Cleveland custom components save space, give smoother operation

By using standardized or custom-built Cleveland Worms & Gears, machine designers overcome the frequently troublesome problem of economically providing a quiet and efficient drive in a limited space. Cleveland components are available not only in standard sets but also in special sizes and ratios. Our wide range of special worm gear production equipment places us in an unparalleled position to furnish worms and gears of special designs. We maintain a complete and perpetual master worm and hob inventory that enables ready duplication of *any* Cleveland worm and gear ever made.

Our engineering specialists will gladly give you complete information on any application where specialized worm gear know-how is required. Call them today—they're as near as your phone. Or write for Catalog 201F—it gives complete data on built-in Cleveland Worms and Gears.

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Worm Gear
Drives

The Cleveland Worm & Gear Company
3264 East 80th St., Cleveland 4, Ohio

A subsidiary of
Eaton Manufacturing Company

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Industry Standard for Lower Maintenance Costs

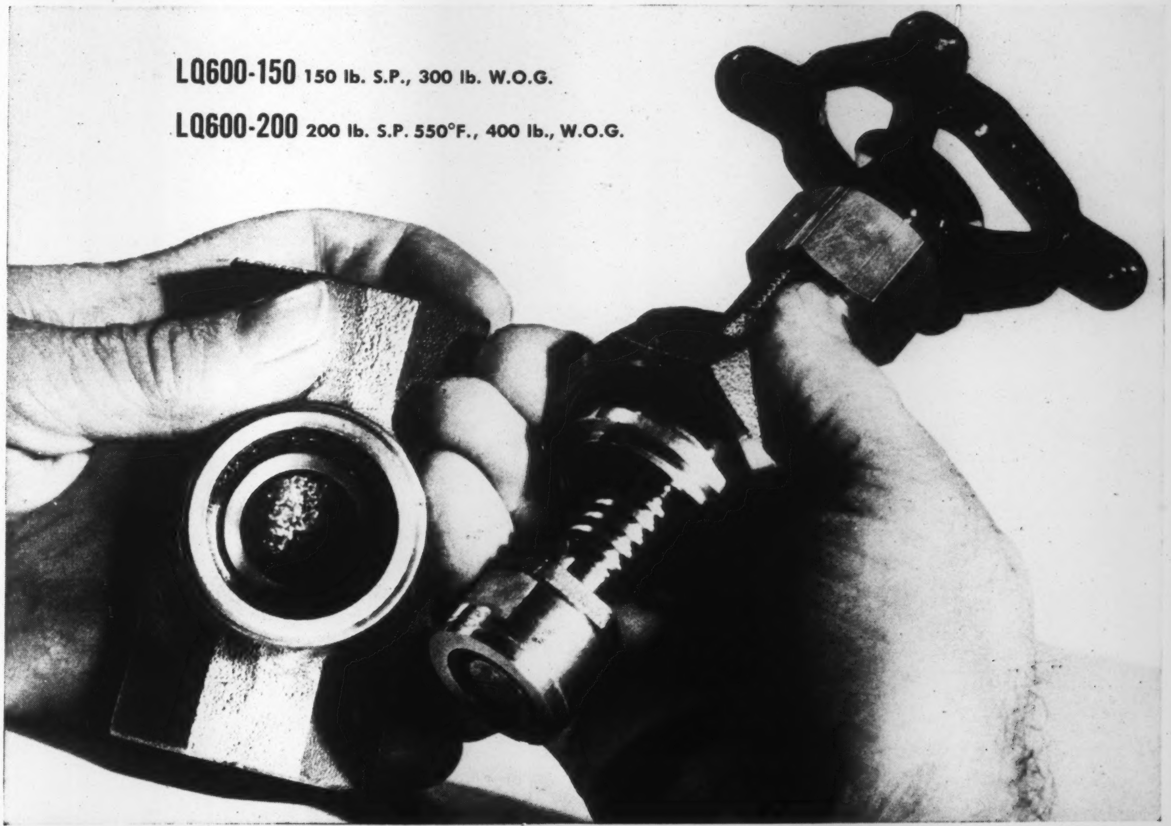
LQ600®

Here's Why: Long accepted valve maintenance costs are a thing of the past in thousands of plants where LQ600's have been installed . . . even in the most severe services where previous valves required repair or replacement after as little as two weeks on the line.

These outstanding savings are made possible by seats and discs of Brinalloy®, a patented Lunkenheimer alloy that is more resistant to wear and corrosion than 500 Brinell Stainless or 1000 Brinell Case-Hardened Stainless Steel.

Add to this the Lunkenheimer exclusive silicon-bronze Stemalloy®, the most durable stem material ever put into a valve, and you have two important reasons why LQ600's have established new low-maintenance standards everywhere they are installed.

For an actual comparison test, call the Lunkenheimer Distributor in your area. He is an expert on valve maintenance costs and will be glad to demonstrate the maintenance-saving benefits you receive when you install LQ600's . . . or write The Lunkenheimer Company, Cincinnati 14, Ohio



LQ600-150 150 lb. S.P., 300 lb. W.O.G.

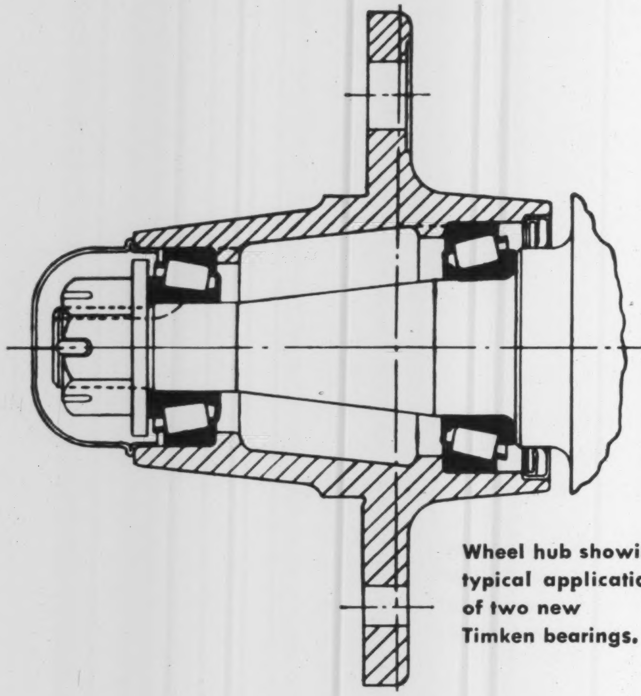
LQ600-200 200 lb. S.P. 550°F., 400 lb., W.O.G.

LUNKENHEIMER QUALITY

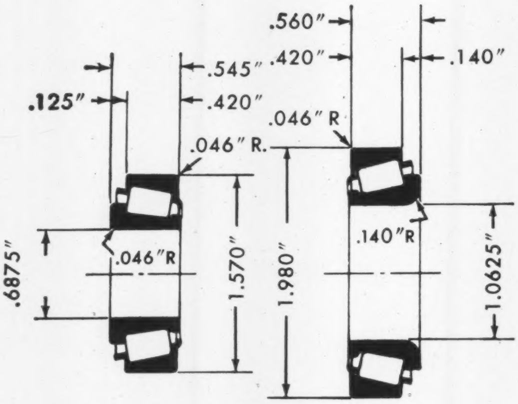
LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

Three new, low-cost TIMKEN® bearings open new design opportunities



Wheel hub showing typical application of two new Timken bearings.



LM 11749—LM 11710
Wt. .181 lb.

L 44649—L 44610
Wt. .256 lb.

ALSO L44643
SAME AS ABOVE
EXCEPT WITH 1" BORE
Wt. .276 lb.

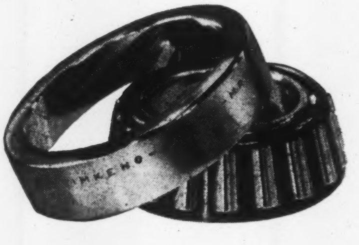
WITH three new small size Timken® bearings, machine designers can now get the advantages of tapered roller bearings where they couldn't be used before. These new, smaller bearings pack high capacity in less space, and they're lower in cost. They permit more compact designs by keeping related parts smaller—provide additional savings in hub materials, seals, nuts and dust caps.

Diagram above at left shows two of them in a typical layout of a front wheel hub for the Automotive Industry's new compact cars. They're the most economical single-row Timken bearings ever produced in bore sizes of 11/16", 1" and 1 1/16". Diagram above at right shows principal dimensions and weights.

Like all Timken bearings, these new Timken tapered roller bearings are geometrically designed and precision-made to roll true. Their taper lets them take *both* radial and thrust loads in any combination. And full-line contact between rollers and races provides extra load-carrying capacity.

Our Sales Engineers will gladly give you complete data, help you design the new bearings into your machines. Timken bearings make any machine better, because Betterness rolls on Timken tapered roller bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



TIMKEN® *TAPERED ROLLER BEARINGS ROLL THE LOAD*